

Amphibians and reptiles from northern Trengganu, Malaysia, with descriptions of two new geckos: *Cnemaspis* and *Cyrtodactylus*

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Synopsis

A collection from the area of Gunong Lawit, northern Trengganu, Malaysia, is described. Records of interest for West Malaysia are of *Microhyla borneensis*, *Rana p. paramacrodon* and *Rhacophorus pardalis*. Two new lizards, *Cyrtodactylus elok* and *Cnemaspis argus*, are described, and a key to the species of *Cnemaspis* in southeast Asia is given. *Goniocephalus herveyi* (Boulenger) is a synonym of *Goniocephalus liogaster* (Günther).

Introduction

Gunong Lawit is a mountain rising to a height of 1519 m (4982 ft) on the border between Ulu Trengganu and Ulu Besut in northern Trengganu State. During the period 22 February to 9 April 1974 an expedition of the British Museum (Natural History) collected certain groups of insects, amphibians, reptiles and some small birds and mammals on G. Lawit and in the lowlands to the east of it. Most collecting of amphibians and reptiles was conducted from three camps, at the Sungei Kelebang and on the east ridge and summit ridge of the mountain.

The Sungei Kelebang camp, 102° 45' 0" E 5° 27' 40" N, at 43 m elevation, in Mukim Ulu Setiu, Ulu Besut, was in an area of regenerating forest that had been selectively logged in 1971. The riverine forest (*Saracca* stream vegetation) had been little disturbed but the other areas were a mosaic of secondary forest and relatively untouched dipterocarp forest, intersected by logging tracks.

The Kelebang drainage is separated from that of the Sungei Petuang by a ridge, Bukit Bok, rising to a height of some 600 m and forming the boundary between Ulu Besut and Ulu Trengganu. A transit camp on the Sungei Petuang, 102° 38' 20" E 5° 26' 20" N, at 250 m, was beyond the reach of the loggers and was surrounded by primary rain forest on the steep hillsides leading to the mountain.

The east ridge camp on Gunong Lawit, 102° 37' 18" E 5° 25' 25" N, at 790 m, was on a ridge top in submontane forest covering the flanks of the mountain. Despite the well-lit forest floor the shrub story was sparse, including mainly palms, such as *Johannesteysmannia*. Most of the collecting was carried out along two swift streams, incised into each side of the ridge, which had their sources not far to the east of the camp. On the summit ridge, 102° 36' 20" E 5° 25' 20" N, at 1280 m, the camp was in montane rain forest, with *Leptospermum* and *Dacrydium* prominent among the trees, a thick understorey of shrubs and palms, and scattered areas of open 'padang', a heathy association of grasses, ferns and small shrubs.

Material collected

GYMNOPHIONA

Family ICHTHYOPHIIDAE

Ichthyophis sp.

MATERIAL. BM. 1974. 4229 (♂).

HABITAT. This specimen was found dead at the edge of a small rocky stream near the Sungei Kelebang camp. The stream had compact gravel beaches of very limited extent, and almost lacked silt, but may have drained from a more favourable area for caecilians.

COLOUR. Dorsum dark brownish grey. A light mustard yellow lateral stripe crosses the nuchal collars, extends forwards to between the eye and the mouth commissure and is almost broken on the second nuchal groove only. The venter is slightly paler than the dorsum and there are no light dorsal or ventral spots or flecks.

REMARKS. The total length is 260 mm, the body width is 10 mm and the tail is very short. There are 318 folds in total, four or five interrupted by the vent and two posterior to it. The grooves fail to meet ventrally on the anterior $\frac{1}{2}$ – $\frac{2}{3}$ of the body. The tooth counts are, premaxillary-maxillary 20–20, prevomeropalatine 21–21, dentary 18–18, splenial 12–12 (these are approximate counts since many of the teeth are missing).

This specimen may well belong to *Ichthyophis supachaii* Taylor, a Malay Peninsula species with a lateral stripe, a considerable number of splenial teeth (18–18) and 313–332 body folds. However, Taylor's description (1968) indicates that *supachaii* has fewer dentary teeth (about 8–8) and probably more teeth in the other series, as well as having a more acutely pointed tail and a flatter head. Since the specimen is also very similar to two other taxa, *I. atricollaris* Taylor, of Borneo, and *I. hypocyanus* (van Hasselt), of Java, and since the extent of variation within and between populations has never been properly assessed I prefer not to apply a name to this specimen.

ANURA

Family PELOBATIDAE

Leptobrachium hasselti

Leptobrachium hasselti Tschudi, 1838.

MATERIAL. BM. 1974. 4228–4249 (16 ♂♂, 5 ♀♀, larvae).

HABITAT. Most specimens were collected along the logging tracks at the Sungei Kelebang camp (43 m). The species was also common around very slow streams in the disturbed forest. Choruses of males were found at a pair of shallow muddy pools at the track edge, at a similar stream a short distance from a track and at a swampy area where disturbance had left many shallow pools and slow streams. Males call from the cover of low vegetation and leaf litter. The pond-type larvae of this species were found only in one slow mud-bottomed stream having a maximum depth of about half a metre.

REMARKS. The call is a soft but carrying hup-hup (Fig. 1).

Leptobrachium heteropus

Leptobrachium heteropus Boulenger, 1900.

MATERIAL. BM. 1974. 4250–4275 (25 ♂♂, 1 ♀).

HABITAT. As reported by Grandison (1972). Specimens were collected in the upper stretches of two streams on the east ridge of G. Lawit at 790 m. The great majority were calling from the leaves of plants and were always less than 40 cm above the stream banks. One male was calling from below a dead leaf on the bank. A few specimens were found on rocks in the stream. A pair took up inguinal amplexus in the collecting bag.

COLOUR. The dorsal surfaces vary from slate grey through purplish grey to pinkish brown. There is frequently ochre mottling and an ochre area covering the snout. The ventral surfaces are grey except for the belly which is white, spotted with dark brown. A black canthal stripe and supratympanic mask, a grey W-shaped mark on the dorsum and pale areas on the elbows are typical. There are both pectoral and femoral glands, which are white.

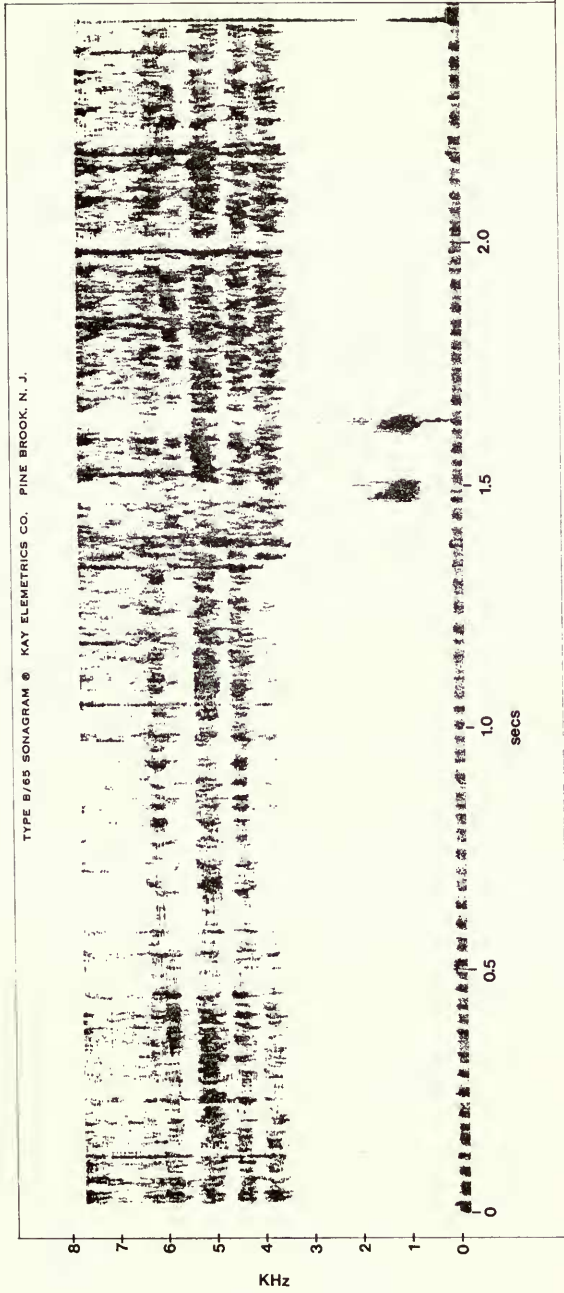


Fig. 1 Sonogram of the mating call of *Leptobranchium hasselti*, high frequency noise is background. Sonograms were prepared using a Kay Electronics Sonagraph 6061B, with the high shape and wide band settings. Calls were recorded on a Uher 4000 Report tape recorder with an AKG type D 190c microphone.

Megophrys aceras

Megalophrys montana var. *aceras* Boulenger, 1903.

MATERIAL. BM. 1974. 4276–4288 (4 ♂♂, 6 ♀♀, 2 juveniles, larvae).

HABITAT. Most of the sample were taken on the east ridge of G. Lawit (790 m) where specimens were caught equally along streams and along dry hillsides. Three were caught between the east ridge and the summit. At 1280 m a specimen was found in a sedgy valley at the edge of a padang, another was found on the summit (1520 m) in forest far from water. Larvae were taken in very shallow, gravelly sections of the east ridge streams. They were found feeding from the surface among stones and dead leaves.

REMARKS. Although Grandison (1972) has listed the differences between *M. aceras* and *M. monticola nasuta*, Berry (1975) has replaced *aceras* in the synonymy of *M. monticola monticola*, a subspecies confined to Java and western Sumatra. *M. monticola* and the Indochinese group comprising *feae*, *carinensis* and *intermedius* are the only *Megophrys* species having two pairs of dorsolateral folds. The inner pair converge slightly as they extend forwards on to the rear edge of the skull. *M. aceras* is like *M. baluensis*, *M. longipes* and the remaining Indochinese species in having only a single pair of dorsolateral folds which curve outwards to meet the posterior part of the supratympanic fold. Frogs of this group also generally have an X- or Y-shaped middorsal ridge. Hypothetically, *M. aceras* and *M. longipes*, montane endemics of the Malay Peninsula, and *M. baluensis*, the montane endemic of Borneo, can be regarded as close relatives of the Indochinese *Megophrys* (exclusive of the *feae* group) and not at all closely related to *M. monticola*. Perhaps these species are recent invaders of, or relicts in, the Sundan subregion.

A recent peninsular Malaysia record of *M. monticola nasuta* (Yong, 1974) has extended the altitudinal range of this form to above 1000 m. Both this form and *M. aceras* have been collected at 488–549 m near Kampong Janda Baik, Pahang, and *aceras* is known to occur as low as 300 m. The two species thus have a broad altitudinal overlap, although *monticola nasuta* is seldom collected at high altitudes in Malaya.

Megophrys monticola nasuta

Ceratophryne nasuta Schlegel, 1858.

MATERIAL. BM. 1974. 4289–4301 (10 ♂♂, 2 immature, larvae).

HABITAT. Males were calling throughout the collecting period from the banks of the Sungei Kelebang and its tributary streams at 43 m. Larvae were found under a stone in a shallow fast-running tributary and among pebbles at the edge of an exposed beach of the Kelebang. The immature frogs were both from 250 to 300 m on the lower slopes of G. Lawit, above the Sungei Petuang. The call is a loud, short honk.

Family BUFONIDAE

Ansonia malayana

Ansonia malayana Inger, 1960.

MATERIAL. BM. 1974. 4304–4319 (10 ♂♂, 5 ♀♀, 1 immature).

HABITAT. Two individuals were caught far from streams on ridge top trails, a male in a crack in a rock exposure near the east ridge camp (790 m) and an immature specimen among dry leaf litter on the forest floor at about 1000 m. The remaining 14 specimens were all caught along small rocky mountain streams. Two of these were among leaf litter and exposed rock faces by a torrent below the east ridge camp. Three were found on damp peat and among the leaves of palms near the summit ridge camp (1280 m). These were in humid, closed canopy forest around a small, stagnant stream. Nearby in an open, mainly grassy area (padang) with stunted *Leptospermum*, *Melostoma* and pitcher plants, nine examples were found along a small stream shaded by trees

and shrubs. The toads were on rocks in the water or on overhanging vegetation as much as 1.5 m above the stream surface.

COLOUR. Dorsum black with fine yellow green to grey green vermiculation. Larger tubercles on dorsum mostly black, tending to form a black XX pattern. Tubercles on flanks and at mouth commissure chrome yellow. Dorsal surfaces of limbs as dorsum, with oblique, yellowish green crossbars. Upper and lower lips spotted with chrome yellow. Throat uniform greyish yellow, belly speckled with chrome yellow. Iris reddish gold to dark brown.

REMARKS. This series agrees closely with the type series of *A. malayana* Inger, from the Larut hills, Perak. The following description is based entirely on the G. Lawit specimens. Males having nuptial pads, mandibular asperities and vocal sac openings are 20.3–23.1 mm in snout–vent length (mean 21.8 mm, N=10). Females with enlarged ova are 24.6–28.0 mm in length (mean 25.9 mm, N=4). Head width relative to SV length is 0.266–0.316 (mean 0.288, N=16) and tibia length relative to SV length is 0.440–0.517 (mean 0.471, N=16). The tips of the outer fingers are weakly expanded (about $1\frac{1}{4}$ times width of narrowest part of digit) and rounded. There is less sexual dimorphism in the extent of the toe web than in the type series. Females have the first and second toes webbed to the tips, the third and fifth with $1\frac{1}{2}$ –2 phalanges free and the fourth with 3 free phalanges. Males have the webbing marginally fuller, with the fleshy edges to the free parts of the digits better developed. In all the males examined the nuptial pad is confined to the dorso-median part of the first finger and metacarpal. The mandibular asperities are small and closely set. They form about 2 rows posteriorly, two to four rows under the front of the lower jaw. The mandibular asperities of the holotype, another Larut hills male and 2 males from Bannang Satar, are identical with those of the G. Lawit males. There is no noticeable sexual dimorphism in the size of the tympanum, which is approximately equal to its distance from the mouth commissure. The yellow tubercle at the mouth commissure varies in size from $\frac{1}{2}$ to $\frac{2}{3}$ of the tympanum diameter. The dorsum is heterogeneously tuberculate, larger oval or rounded tubercles are separated by small conical ones. The smaller tubercles are capped by one, and the larger tubercles by up to six, white spicules. There is slight individual variation in the size and prominence of the dorsal tubercles. In all specimens there is a fine lichenate vermiculation of green on black covering the dorsal surfaces. In addition a characteristic XX pattern, which may be more or less broken up, is present on the dorsum. The first X extends from the supraocular area to above the scapulae, the second extends back on to the sacrum. There is frequently a pale middorsal patch enclosed by the arms of the two crosses. Chromatophores are absent from parts of the ventral surface of all specimens. These areas are transparent, apart from the whitish glands lying beneath the tubercles. The ventrolateral tubercles are each capped with yellowish pigment, as in the type series. In no specimens is there a ventral pattern of yellow marbling like that found in the series from Tasan and noted by Inger (1960). BM specimens referable to this species are from the Larut Hills and G. Keledang, Perak, from G. Tahan, Pahang, from G. Lawit and from Bannang Satar, Yala, Thailand. Measurements for the combined sample are similar to those from the G. Lawit series. SV adult ♂♂ 20.2–23.1 mm (mean 21.6 mm, N=14), adult ♀♀ 24.6–28.6 mm (mean 26.6 mm, N=8). HW/SV=0.266–0.316 (mean 0.286, N=25). Tibia/SV=0.440–0.517 (mean 0.475, N=25). Except for the specimens from Bannang Satar (a lowland locality), for which there are no data, this species has been collected between 640 and 1280 m. The call is a rapid metallic ticking (Fig. 2).

A. malayana belongs to a group of 3–5 species in the Malay peninsula, 4 in Borneo and 1 in south-west India having the following characters. Snout acuminate, tympanum visible externally, first finger does not reach disc of second when adpressed. Tips of digits rounded or weakly spatulate but not greatly expanded. Nuptial pad present or absent, if present covered with minute spicules, not larger spines. Mandibular asperities present or absent. Vocal sac present, or possibly absent in *A. tiomanica*. The Malay Peninsula forms of this group are discussed below.

Gunong Benom is one of the most isolated mountains in the southern Malay Peninsula. The *Ansonia* reported from c. 1000 m on the mountain by Grandison (1972) have been compared with material, including the types, of *A. malayana* and *A. tiomanica* Hendrickson. They are more similar to *malayana* than to *tiomanica* but differ from *malayana* in the following characters.

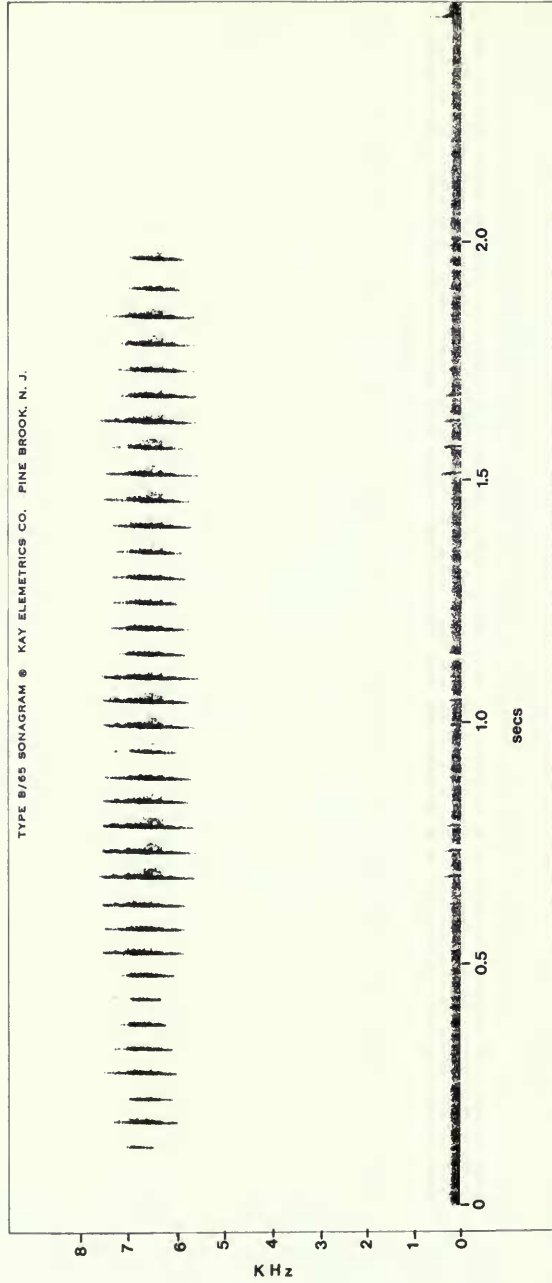


Fig. 2 Sonagram of the mating call of *Ansonia malayana*, recorded at 1280 m elevation.

Larger size, ♂ 25.4 mm, ♀ 30.2 mm in SV length.

♂ lacks a nuptial pad despite having a vocal sac and mandibular asperities.

♀ with enlarged tympanum, diameter twice as great as its distance from the mouth commissure.

Distinctive dorsal lichenation of *A. malayana* absent. XX pattern on dorsum indistinct or absent. Dark brown and chrome yellow in life without lichen green areas.

The examination of a larger series of *A. malayana* than was available to Grandison shows that there is variation in the extent of the webbing and in the development of the dorsal tubercles and tubercle at the mouth commissure. Nonetheless, the G. Benom specimens are extreme in these characters, as indicated by Grandison. The size and arrangement of the mandibular asperities, however, is identical to that in *malayana* (excluding the Tasan series reported by Inger (1960) which is discussed below). Head width of G. Benom frogs relative to snout-vent length 0.281–0.300 (mean 0.292, N=3). Tibia length relative to snout-vent length 0.474–0.496 (mean 0.482, N=3). These specimens may represent a species distinct from *A. malayana*.

The Tasan (Ban Tha San) frogs differ from *malayana* in the characters stated by Inger (1960) and in some others. Because of the 200 mile collecting hiatus between the Isthmus of Kra and the southern Malay Peninsula these differences may be due to geographic variation. They are as follows.

Larger size, adult ♂♂ 21.9–24.2 mm (mean 22.7 mm, N=14), adult ♀♀ 27.1–28.7 mm (mean 27.5 mm, N=7).

Nuptial pad extends on to basal part of dorso-median surface of second finger.

Mandibular asperities large, well separated and forming a single row.

Ventral surfaces of abdomen and thighs patched and marbled with yellow pigment which covers an area equal to or greater than the dark areas. (Ventral yellow pigment always confined to isolated tubercles in *A. malayana* and the G. Benom population.)

Head slightly wider. HW/SV 0.270–0.328 (mean 0.300, N=21).

The ratio of tibia length to snout-vent length falls within the range of *A. malayana*. Tibia/SV 0.453–0.508 (mean 0.487, N=16).

The remaining two Malayan species of this group are more similar to each other in size than to the three populations discussed above. *A. penangensis* (*sensu* Inger, 1960) was placed in the group of larger species having the first finger subequal to the second when adpressed. The two specimens described by Inger have been re-examined. The whole of one specimen, and the hind limbs of the other are desiccated. However, the first fingers of the better preserved specimen, and the first fingers of juveniles from the larval series described by Flower (1899) are much shorter than the second fingers. The tip of the first finger reaches only to the distal half of the penultimate phalange of the second, when the two fingers are adpressed. The tip of the first finger of *malayana* reaches the middle of the penultimate phalange when the first and second fingers are adpressed. *A. penangensis* is like *malayana* in other characters too. The first toe is webbed to the tip, the second to the terminal phalange. There are about 1½ phalanges of the third and fifth toes free and about 3 free phalanges of the fourth toe. The dorsum, although having scattered light coloured areas, also has a dark XX identical to that characteristic of *malayana*. There are oblique light stripes on the limbs and pale-tipped tubercles on the ventrolateral areas as in *malayana* too. This pattern is particularly distinct on the Penang juveniles which could as well be referred to *malayana* as to *penangensis*. *A. penangensis* is also similar in habitus to *A. malayana*, the ratios HW/SV (0.282 and 0.285 in *penangensis*, mean 0.286 in *malayana*) and tibia/SV (0.481 and 0.482 in *penangensis*, mean 0.475 in *malayana*) are identical in the two species. *Ansonia penangensis* (*sensu* Inger) appears to differ from *malayana* only, but markedly, in size, the gravid ♀ being 37.2 mm in length. The two adults and the larval series were collected on Penang Hill at 1800–2000 ft (550–610 m) in March 1898 by Captain S. S. Flower.

Ansonia tiomanica Hendrickson is similar to *A. penangensis* in size but is very different in habitus (see Hendrickson, 1966, Plate 10). This is perhaps reflected in the HW/SV ratio of 0.257 (♀) and 0.268 (♂) which is lower than that of *penangensis* and at the bottom of the range for *malayana*. The tips of the third and fourth fingers are weakly expanded (twice the width of the narrowest

part of the digit) and weakly spatulate as stated by Hendrickson (1966). Again, as stated by Hendrickson, the toe webbing is greatly reduced.

First	Second	Third	Fourth	Fifth
1	$2\frac{1}{2} : 1\frac{1}{2}-2$	$2\frac{1}{2} : 2$	4 : 4	$2-2\frac{1}{2}$

There is much less webbing than in any of the forms discussed above, including the G. Benom population. The median edge of the outer metatarsal tubercle is frequently indistinct in preserved *Ansonia*. In *A. tiomanica* the tubercle is rather heart-shaped and in contact with the inner metatarsal tubercle as described by Hendrickson (1966), but there is a similar condition in some specimens of many other taxa. The dorsum is covered by close-packed, homogeneous, rounded tubercles which contrast strikingly with the heterogeneous tubercles of the three small forms. The Penang specimens are too poorly preserved to show whether the dorsal tuberculation was heterogeneous or homogeneous. The dorsal pattern also differs from the other populations, but is most similar to that of the G. Benom specimens. It is composed of discrete whitish spots covering 1-3 tubercles on a uniform dark brown background. Finally, the male, although having enlarged testes, differs in secondary sexual characteristics from sexually mature males of the small forms. It has no vocal sac (contrary to Hendrickson's statement), there is no nuptial pad (as in the G. Benom population) and the mandibular asperities are not distinct from those on the gular skin.

Ansonia sp.

Ansonia leptopus, Grandison, 1972.

MATERIAL. BM. 1974. 4302-4303 (2 ♂♂).

HABITAT. This species was found in a small right bank tributary of the Sungei Kelebang at 43 m. Two other species, *Rana laticeps* and *Amolops larutensis*, were apparently also confined in the area to this fast, rocky stream, the only one of its type seen in the area. Both *Ansonia* specimens were caught at night on small rocks projecting from the water in shallow swift sections of the stream.

COLOUR. Dorsum dark reddish brown, canthal and tympanic areas and lips blackish. Throat and anterior belly dark grey or black, posterior belly grey brown. A dull reddish or orangy speckling on ventral surfaces. Hidden surfaces of limbs as venter. Iris dull orange, reticulated with black forming dark patches at the ends of the pupil.

REMARKS. Although no call was heard in the field one specimen gave a low clucking call in the collecting bag (Fig. 3). This call was quite unlike the ticking call of *A. malayana*.

These specimens, and two ♂♂ in the BM(NH) from the Ulu Tahan area, north Pahang, are identical with the series reported on by Grandison (1972) as *A. leptopus* (Günther). These Malay Peninsula specimens have the following characters. Gravid ♀ 51.0 mm in length, tibia/SV=0.518. Mature ♂♂ 35.6-41.3 mm in length (mean 38.0 mm, N=9), tibia/SV=0.474-0.507 (mean 0.488, N=8). Vocal sacs with bilateral openings in all 9 ♂♂. Nuptial pads always confined to dorsomedial surface of first metacarpal and first finger, covered with small brown spinules. Mandibular asperities formed by a single or double series of low ridged tubercles, each covered with a rounded cap of keratin and lacking spines. Similar asperities along the upper lip. No group of asperities under mandibular symphysis. Dorsum covered with low rounded tubercles with similar weakly keratinized tips. Because of their nuptial pads, because the nine similarly sized ♂♂ represent three independent collections, and because one male was collected in amplexus (Grandison, 1972) it is unlikely that the weak development of their asperities is due to the individuals not being at the peak of breeding condition. Free phalanges of toes in males as follows:

First	Second	Third	Fourth	Fifth
0	$1\frac{1}{2}-2 : 0$	$2-2\frac{1}{2} : 1-2$	$3\frac{1}{3} : 3\frac{1}{4}-3\frac{1}{2}$	$1\frac{1}{2}-2$

Four Bornean taxa seem to be most closely related to this population. *Ansonia leptopus* (Günther) is similar to the Malay Peninsula population in having reduced toe webbing and weak mandibular

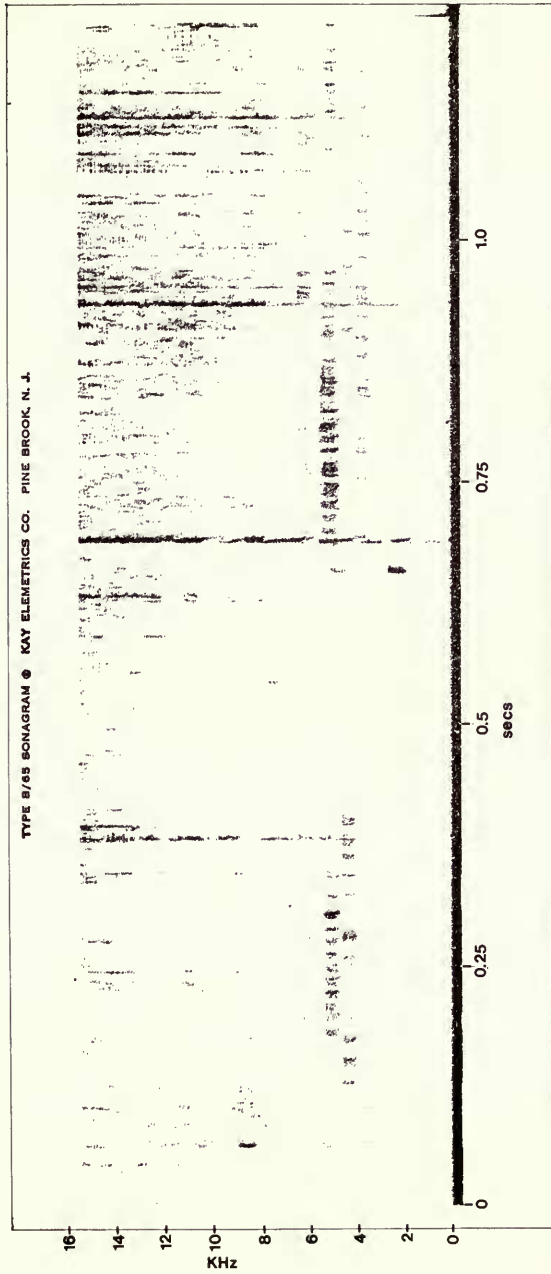


Fig. 3 Sonogram of a call of *Ansonia* sp., recorded in a collecting bag.

asperities. *A. longidigita gryllivoca* Inger is similar in lacking major sexual dimorphism in the development of the dorsal tubercles and in having weak mandibular asperities. The remaining two forms of this group, *A. l. longidigita* Inger and *A. gubei* Inger, are less similar to Malay Peninsula frogs than are either of the above forms. *A. leptopus* has marginally less extensive webbing than the Malayan frogs. Males have the web between the first and third toes more deeply incised so that the terminal phalange of the first and second toe is free; 2-2½ phalanges of the third and fifth toes are free, 3½-4 (usually 4) phalanges of the fourth toe are also free of web. Males have mandibular asperities in one or two rows as in Malayan frogs, but they are formed of conical tubercles capped by keratin spikes quite unlike the inconspicuous asperities of the Malayan sample. They also have a group of similar asperities under the mandibular symphysis (lacking in Malayan frogs) and lack asperities along the upper jaw (present in Malayan frogs). Finally, all males of *leptopus* except FMNH 77449 (Inger, 1960) have the dorsum covered with massive tubercles capped by high spines, while tubercles on the flanks and limbs are also spinose. Five mature males of *A. leptopus* have been reported (Inger, 1960) to be 34.2-35.8 mm in length but one BM male from Kinabalu, 42.5 mm long, shows that they may be as large as Malayan males. Male *A. longidigita gryllivoca* correspond with males of the Malayan population in having weak asperities along both the mandible and upper lip, and in the size and degree of keratinization of the dorsal tubercles. They differ in having the mandibular asperities conical, rather than ridge shaped, in having a group of asperities under the mandibular symphysis and in having more extensive webbing. Webbing on the third and fifth toes generally reaches the terminal phalanges and there are about three phalanges on the fourth toe unwebbed. They are also smaller, SV length 32.8-38.3 mm (mean 35.09 mm, N=24), and in about a third of males the nuptial pad extends onto the second finger (Inger, 1960). All the Bornean forms have been reported to have only one vocal sac opening, on left or right, while the Malay Peninsula males have bilateral vocal sac openings. On the basis of these differences I find it impossible to assign the Malayan population to either *A. leptopus* or *A. longidigita* and prefer to leave it unnamed. Further collecting of *Ansonia*, both in the lowlands and highlands of the peninsula should be rewarding.

Bufo asper

Bufo asper Gravenhorst, 1829.

MATERIAL. BM. 1974. 4320-4359 (2 ♂♂, 4 subadults, 29 juveniles).

HABITAT. Most specimens are recently metamorphosed juveniles, which were extremely common on stony river beaches of both the Kelebang (43 m) and the Petuang (250 m), from the start of collecting. Although adults and subadults were confined to the rivers, immature specimens were occasionally found along logging tracks and small streams at the Kelebang. On the east ridge of G. Lawit 3 specimens were caught in the valleys of small mountain streams at c. 790 m.

RANGE. Reports of this species from the Indochinese region appear in Boulenger (1893), Smith (1915) and Cochran (1930). Boulenger (1893) recorded the species from Tagata Juwa, Kawthoolei and there is one adult in the BM from the country along the Me Ping and Me Taw rivers, north west of Tak, nearby in Thailand. These are the northernmost locality records for both *B. asper* and *Rana blythi*, and apparently neither of these Sundan species is present beyond the hill tract between the Chao Phraya lowlands and the Andaman Sea, and north of about 17° N latitude.

Bufo parvus

Bufo parvus Boulenger, 1887b.

MATERIAL. BM. 1974. 4360-4407 (36 ♂♂, 4 ♀♀, 7 immature, larvae).

HABITAT. One subadult female was caught on the forest floor of Bukit Bok, the watershed between the Kelebang and the Petuang, at about 520 m. Mature males were caught along logging tracks at the Sungei Kelebang (43 m). Males were calling in chorus from among grass and low herbs at track edges and occasionally from bare mud or in the edges of the water. Gravid ♀♀ were also

collected along the logging tracks, but one was among leaf litter on the bank of a small muddy stream in logged forest. Spawning sites were in water-filled ruts in the track and in a pair of shallow muddy pools at the track edge. Juveniles were caught in the camp site and along a small rocky forest stream.

REMARKS. The larvae are identical to those described by Smith (1916) from Khao Sebab in south-east Thailand.

Bufo quadriporcatus

Bufo quadriporcatus Boulenger, 1887b.

MATERIAL. BM. 1974. 4408–4409 (2 juveniles).

HABITAT. Both were caught in the vicinity of the Sungei Kelebang camp site.

COLOUR. The larger specimen was red brown dorsally with a dark-edged light canthal and dorso-lateral stripe. The throat was red brown with white spots, the belly dirty white with grey brown spots.

Cacophryne borbonica

Hylaplesia borbonica Tschudi, 1838.

MATERIAL. BM. 1974. 4410 (juvenile).

HABITAT. The specimen was caught on the forest floor on the hillside above the Sungei Petuang camp, at about 300 m.

Pedostibes hosei

Nectophryne hosii Boulenger, 1892.

MATERIAL. BM. 1974. 4411–4422 (11 ♂♂, 1 ♀).

HABITAT. Ten were caught on the banks of the Sungei Kelebang (43 m). During the first collecting period (22 February–8 March) males were calling from logs and branches above the river, either on the steep earth and rock banks or as high as 4 m from the forest floor and 5 m above the river. The female was found in a hole in the rock bank of the river. On the night of 8 March many males were heard calling from high in mature trees on the rocky banks of the Sungei Petuang, but none was caught. The call is a groaning croak. By 28 March breeding must have been over for no further calls were heard either at the Petuang or at the Kelebang. Two males collected at the Petuang were both on the steep rocky banks of a small tributary.

COLOUR. Males are khaki to chestnut brown on the dorsal surfaces. The throat is grey with small indistinct yellow spots, the belly is a dirty bluish white, also indistinctly marked with pale yellow. The back of the thigh is greyish. The female was more brightly coloured. The dorsum at night was dark purplish brown with yellow blotches. By day the dorsum was medium green, darkening over the vertebral area and fading to bluish on the flanks and hidden surfaces of the limbs. There were bright yellow markings ringed with darker green on the dorsum and flanks. The iris is golden brown reticulated with black and greyish at the ends of the pupil.

Family MICROHYLIDAE

Kalophrynus pleurostigma pleurostigma

Kalophrynus pleurostigma Tschudi, 1838.

MATERIAL. BM. 1974. 4423–4425 (2 ♂♂, 1 ♀).

HABITAT. Among leaf litter in secondary trackside vegetation and logged forest at the Sungei Kelebang (43 m).

REMARKS. Inger (1966) gave measurements of 21 Bornean *pleurostigma*. I have reexamined the 6 BM(NH) specimens which formed part of his material. The smallest adult female, from Gunong Dulit, is 35.2 mm in length and is probably the specimen on which Inger's lowest size limit for Bornean females was founded. On the basis of its dorsal pattern and short fourth finger it is not a *pleurostigma*. The smallest Bornean adult female which I have seen is 39.3 mm in length. Reinterpreting Inger's data on the basis of a little additional material, snout-vent lengths of adult *pleurostigma* are as shown in Table 1.

Table 1 Snout-vent lengths (mm) in three populations of *Kalophrynus pleurostigma*

	Range	Males			Females		
		Mean	N	Range	Mean	N	
Borneo	36.8-50.4	43.6	16	? 39.3-57.8	48.0	10	
Bunguran	42.8-46.2	44.3	4				
Peninsula*	35.0-41.2	37.9	7	38.2-45.8	42.9	6	

* Malay Peninsula to just north of the Isthmus of Kra.

In comparison with this, 3 of the 7 Malayan specimens smaller than 35 mm in the BM(NH) are plainly adult. A male from 915 m on G. Tahan has nuptial pads like those of *pleurostigma*, is 28.8 mm in length and has a faint dorsal pattern unlike that of any *pleurostigma* and a massive inguinal dark patch extending onto the anterior face of the thigh. Two gravid females are 30.4 and 34.4 mm in length, lack a dorsal pattern, but have a well-developed dark inguinal spot without a light edge. They are from the base of G. Pulai, Johore and from Kampong Janda Baik, at about 500 m in Pahang. All 3 specimens have relative toe and finger lengths like those of *pleurostigma*. Unless there is remarkable size variation in *K. pleurostigma* these specimens represent one or two Malay Peninsula species, intermediate in size between *K. robinsoni* (five adults are 17-18 mm in length, altitudinal distribution 165-990 m) and *K. pleurostigma* (found in the lowlands of Malaya, but up to 2200 m on Kinabalu). Berry (1972) has shown that there are two types of *Kalophrynus* larvae in West Malaysia, one type was collected at Kampong Janda Baik.

Metaphrynella pollicaris

Phrynella pollicaris Boulenger, 1890.

MATERIAL. BM. 1974. 4426-4436 (11 ♂♂).

HABITAT. Found from 780 m to near the summit (1520 m), both in the tall forest of the intermediate zone and high altitude forest. Five males from the east ridge camp (790 m) were calling from elliptical holes in tree trunks and branches and were thus in a situation similar to that reported (Grandison, 1972) for Pahang examples. The minimum diameter of bole in which occupied holes were found was likewise found to be similar (about 8 cm). In two cases specimens were taken from holes in saplings used in the construction of the camp. On the east ridge the frogs were only heard calling at night. The five from the higher camp (1290 m) and one from just below the summit (c. 1500 m) occupied similar holes. At those elevations calling commenced in the late morning, perhaps due to the dull conditions, with very low cloud cover. Holes from which males called were found from $\frac{1}{2}$ to 6 m above the ground, and were probably to be found at higher levels also. One specimen was calling from the outside of an inclined tree trunk, about a metre from a hole from which another male also called. Here tones of the call seemed to differ with the calling post, the specimen in the hole having a deeper call than that on the trunk. Around the higher camp *Metaphrynella* was found in both the more typical closed canopy forest and on the edges of padang where the trees were interspersed with grass, bushes and some stunted *Dacrydium*. The call is shown in Fig. 4.

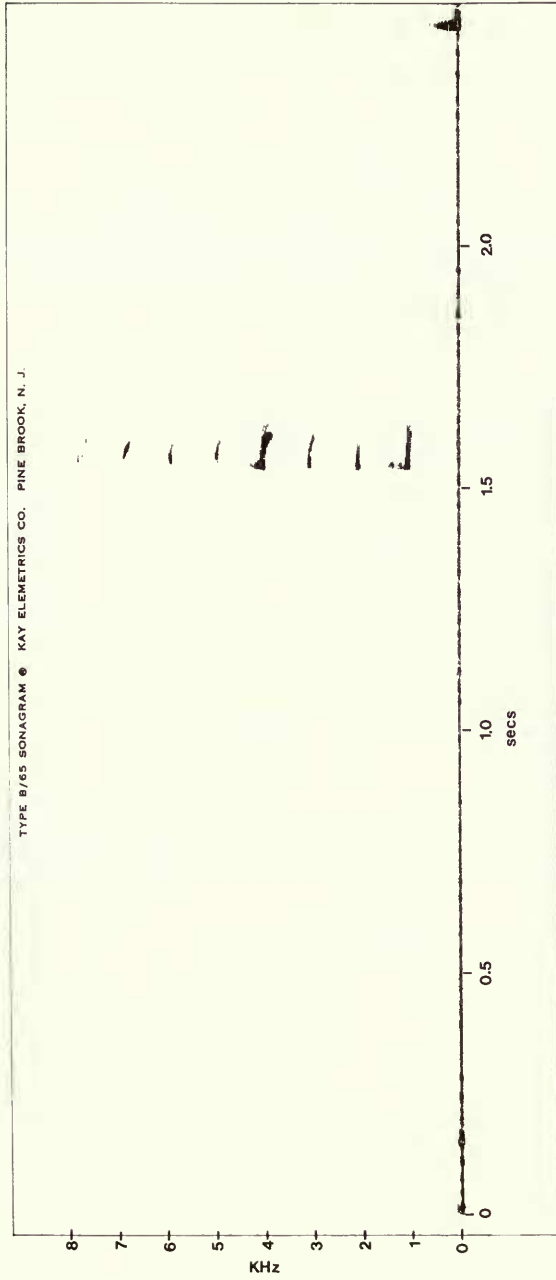


Fig. 4 Sonagram of the mating call of *Metaphrynella pollicaris*, recorded at 790 m elevation.

COLOUR. From dark greyish brown to pale ochre in life. A constant dark middorsal patch forking behind towards the posterior flanks and continuous, when the legs are flexed, with the dark cross-bar on the thigh.

REMARKS. Grandison (1972) noted a size difference between low and high altitude populations on G. Benom. There are now 46 specimens of *M. pollicaris* in the BM(NH) (mostly from below 1500 m) which confirm this difference but do not suggest a cline of size increasing with altitude.

The lower altitude population is found from *c.* 500–1500 m but shows no evidence of a size cline over this range. At these elevations males with vocal sac openings and well-developed pre-pollices are 24.2–34.0 mm in length (mean 29.2 mm, N=27), females are 26.6–27.9 mm (mean 27.2 mm, N=3). Examples in the BM(NH) are from the Larut Hills (915–1370 m) and Jor (550 m), Perak; from Bukit Fraser, Selangor; from Kg. Janda Baik (*c.* 500 m) and from G. Benom (900–1220 m), Pahang; and from G. Lawit (790–1500 m).

The higher altitude population is known only from the males reported by Grandison (from 1680 to 1900 m on G. Benom) and from 2 males from about 1525 m on the Cameron Highlands. These specimens are 34.2–40.9 mm in length (mean 38.5 mm, N=12).

Microhyla berdmorei

Engystoma berdmorei Blyth, 1856.

MATERIAL. BM. 1974. 4437–4446 (4 ♂♂, 5 ♀♀ and larvae).

HABITAT. The whole sample was collected from logging tracks at the Sungei Kelebang camp. Some specimens were on mud or in flooded ruts but most were in trackside vegetation. In many areas this was a mass of grass and herbaceous plants with fallen branches and overhung by the low trees bordering the track. In one case at least a specimen was collected on clear ground with leaf litter between the saplings just behind the forest edge. This specimen was calling, apparently in chorus with *M. borneensis*. In other areas of trackside *M. berdmorei* was found with *M. heymonsi* and probably with *M. butleri* too.

Microhyla borneensis

Microhyla borneense Parker, 1928.

MATERIAL. BM. 1974. 4447–4452 (6 ♂♂).

HABITAT. Five specimens were collected on the nights of 4–6 April in one small area of secondary trackside growth. The vegetation consisted of slender saplings and rattan and the ground was dry and covered by dead leaves. A flooded rut in the otherwise dry track provided a possible breeding site. *M. berdmorei* was also present at this site, where a chorus of *Microhyla* were calling from the forest floor. The remaining specimen was calling from beneath a dead leaf on the forest floor at the edge of a swampy area from which the mature trees had been removed.

COLOUR. The pattern is as described by Inger (1966). The dorsum is brown to dark grey. There are two oval fawn patches between the scapular and middorsal expansions of the pattern. The throat is dark grey, the belly colourless to fawnish posteriorly. The iris is pale brown above, darker below.

REMARKS. This species has not previously been recorded outside Borneo. A further male, BM. 1928. 11.12.1, which was previously discussed as *M. annectans*, by Smith (1916*b*), Inger (1966) and Grandison (1972), is identical with this series and with two Bornean specimens including the holotype. It extends the range to Klong Bang Lai, *c.* 60 km north of the Isthmus of Kra. Snout–vent lengths of the six Malayan males, all of which have vocal sac openings, are 17.3–20.6 mm (mean 19.4 mm). Tibia lengths relative to snout–vent lengths are 0.563–0.659 (mean 0.613, N=5).

M. borneensis has two close relatives. *M. annectans* is endemic to mountains of the Malay Peninsula (Grandison, 1972). *M. annamensis* of the southern Vietnamese mountains has a warty dorsum, lacks an outer metatarsal tubercle and has a different pattern.

Microhyla butleri

Microhyla butleri Boulenger, 1900.

MATERIAL. BM. 1974. 4453 (♂).

HABITAT. From an overgrown mound of earth turned up at the edge of a logging track at the Kelebang.

Microhyla heymonsi

Microhyla heymonsi Vogt, 1911.

MATERIAL. BM. 1974. 4454–4467 (11 ♂♂, 4 ♀♀ and larvae).

HABITAT. *Microhyla heymonsi* was found calling in chorus from the edges of the logging tracks at the Sungei Kelebang. Males were collected from these choruses throughout the collecting period. One specimen was found half a metre above the track edge on a leaf in the low vegetation from which males were calling. All the others for which there are data were found on mud near the edges of flooded ruts and other pools or on earth at the edges of drier parts of the track. All these specimens were protected by fallen twigs and dead leaves, and often by a thin growth of vines and herbaceous plants. One pair, taken in amplexus, was located by the male's call. *M. heymonsi* was by far the commonest *Microhyla* at the Kelebang. The call is a rapid ticking (Fig. 5) like that of the other species of *Microhyla* heard calling around the camp.

Family RANIDAE

Amolops larutensis

Rana larutensis Boulenger, 1899.

MATERIAL. BM. 1974. 4468–4481 (5 ♀♀, 8 juveniles, eggs).

HABITAT. With *Rana laticeps* this was the only frog collected at all camps from 43 to 1280 m. It was taken only from the fast, clear, rocky streams and torrents which would provide a suitable habitat for the larva. Juveniles were found, with *R. laticeps* and *Ansonia* sp., along a gently inclined stream of this type near the Sungei Kelebang. None of these 3 species was present along nearby turbid streams. A mass of hundreds of eggs was suspended from the undersurface of a rock over a fast torrent of this stream.

Ooeidozyga laevis laevis

Oxyglossus laevis Günther, 1858.

MATERIAL. BM. 1974. 4482–4513 (3 ♂♂, 5 ♀♀, 24 immature and juveniles).

HABITAT. This was one of the commonest species along the logging tracks at the Sungei Kelebang camp, where it was found in flooded ruts and other shallow muddy pools. A single specimen was found by a shallow muddy stream in disturbed forest near a logging track but otherwise this frog, like *Rana limnocharis*, seemed to be unable to invade the regenerating forest.

Rana baramica

Rana baramica Boettger, 1901.

MATERIAL. BM. 1974. 4514–4518 (4 ♂♂, 1 gravid ♀).

HABITAT. All specimens were obtained in the disturbed forest around the Sungei Kelebang camp (43 m). This seems to be a secretive ground dwelling frog like *R. glandulosa* and *R. signata*. Five were heard calling, one at the beginning of March (the end of the first collecting period), the others

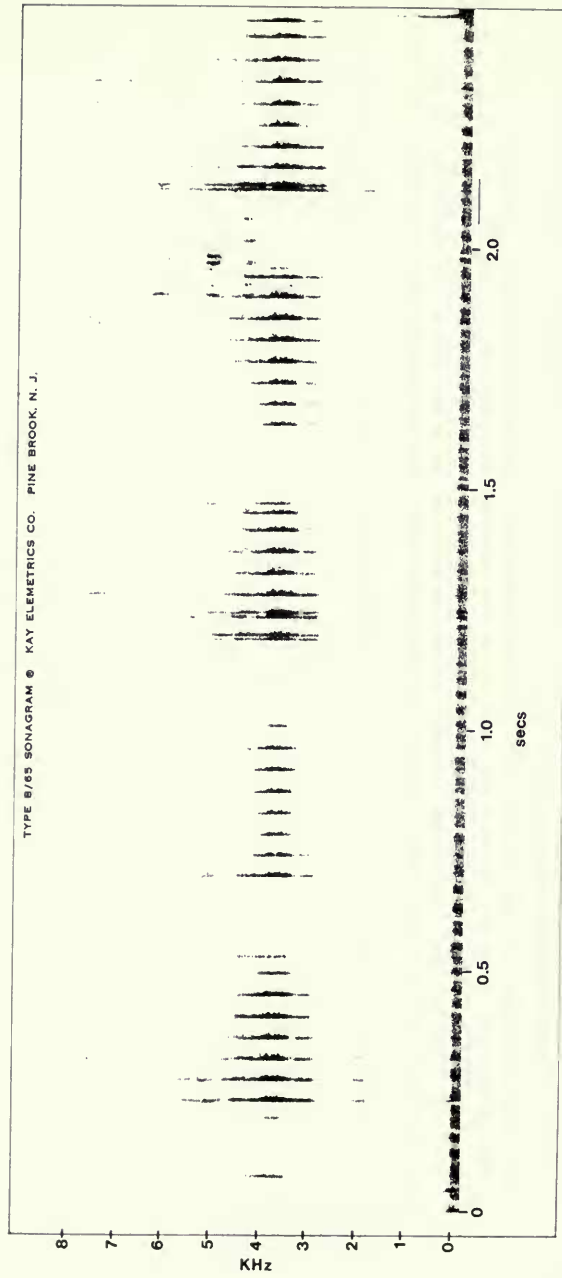


Fig. 5 Sonagram of the mating call of *Microhyla heymonsi*.

from 3 to 9 April. The first specimen heard was apparently in a tangle of sticks and leaves among the roots of a palm at the edge of a shallow earth banked stream. It was not collected. The first specimen caught was also calling from the roots of a bush, but in thick secondary trackside vegetation. It was about 30 cm above ground level. Two more specimens were caught while calling from a tangle of uprooted tree trunks and branches overgrown with creepers, on the banks of the Kelebang. Another specimen called from a large cavity in a rotten felled tree trunk in thick secondary growth. The female was found among a litter of rotten bark and wood by a log in thick secondary vegetation about 3 m from a logging track. It contains enlarged unpigmented ova. The calling sites of this frog were reminiscent of those of *R. signata*, which calls from tangles of roots and sticks, but on riverbanks. Calling was frequently heard at dusk, but continued into the night. The call is a loud 'yip yip yip . . .' (Fig. 6).

COLOUR. Dorsum and flanks very dark brown with pale dappling and a golden refracted gleam. Tympanum almost black. Edge of supraorbital area barred black and white or fawn. Upper lip the same, lower lip barred white on black. Ground colour of belly and lower flanks white to pale grey and almost obscured by rounded black and brown patches. Throat white to dark brown almost obscured by black mottling, with a white median line. Hind limbs very dark above with indistinct darker cross bars. Posterior thigh dark brown with black spots. Limbs greyish below mottled with black. Iris tin coloured to fawn in dorsal third, lower two-thirds very dark brown.

Rana blythi

Rana macrodon var. *blythi* Boulenger, 1920.

MATERIAL. BM. 1974. 4519–4550 (10 ♂♂, 9 ♀♀, 11 immature, eggs).

HABITAT. This was the commonest river frog at the Sungei Kelebang (43 m) and was also collected at the Petuang and at 790 m on the east ridge of G. Lawit. Around the Kelebang it was found in all areas close to water. Mature males and gravid females were taken equally on river beaches, along small streams in forest and by temporary trackside pools. Immature frogs of all sizes were taken in a similar range of habitats. The largest of the adult frogs, however, seemed to be confined to shingle river beaches. On the east ridge of G. Lawit this species occupied shallow gravel pools in mountain streams, where it must have been in competition with *R. kuhli*.

R. blythi has unpigmented eggs, which indicates (Salthe and Duellman, 1973) that the site of egg deposition may be specialized. A pebble nest, believed to belong to *R. blythi*, was found near the mouth of a tributary stream of the Sungei Petuang at 250 m. Eggs removed from the nest are unpigmented, 2–2.3 mm in diameter and 3–3.5 mm across the capsule. Mature oviducal ova from a preserved *blythi* are c. 2 mm in diameter. An outer ring of pebbles, about 60 cm in diameter, was built out into the stream from the pebble beach. Although the level of the stream fluctuated widely, at the time of observation this barrier broke the surface except on the upstream side, on which a current of water entered the nest. Stones had apparently been scraped up from within this ring to form a central pile, below the water surface, leaving an inner ring of smaller pebbles and gravel. No eggs were visible externally, but on removing a few large stones from the pile eggs were found dispersed through the pebbles and loosely adherent to them. During the day *R. blythi* was seen on the banks near the nest. Before collecting at night, the nest was revisited and a large *blythi* found on it. Later, 2 non-gravid females were caught in the nest area. Mackinnon (1975, pp. 147–148) records similar behaviour in an unnamed large *Rana* on the Sungai Segama in Sabah. Nest building may be important to *blythi* as a form of behaviour protecting the spawn and newly hatched larvae against the stream current. Territorial behaviour and parental guarding of the nest should be looked for in this species.

REMARKS. As already noted (p. 190) this Sundan species extends from the Malay Peninsula northwards to Changwat Tak, Thailand. It is apparently confined in the Indochinese subregion to the hill tract between the Andaman Sea and the Chao Phraya lowlands of Thailand.

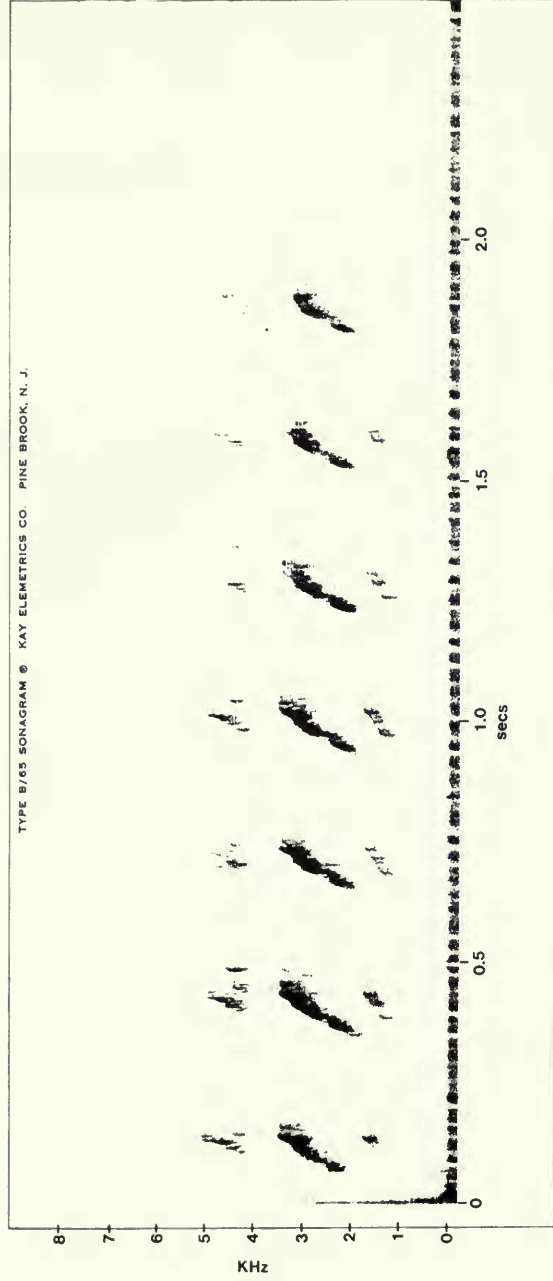


Fig. 6 Sonagram of the mating call of *Rana baranica*, background noise has been removed.

Rana chalconota raniceps

Polypedates raniceps Peters, 1871.

MATERIAL. BM. 1974. 4551–4626 (41 ♂♂, 19 ♀♀, 15 juveniles, larvae).

HABITAT. This riparian species was found in all areas near water at the Sungei Kelebang, including the flooded areas of logging tracks, and small streams in logged forest. Most were low on vegetation but some were up to 1½ m above ground. Males call from these positions. The call is a soft 'pink pink' like dripping water. The species was also found at the Sungei Petuang at 250 m.

Rana hosei

Rana hosii Boulenger, 1891b.

MATERIAL. BM. 1974. 4627–4640 (8 ♂♂, 6 ♀♀).

HABITAT. Six specimens were found at the Sungei Kelebang, on the river banks and up to 20 m from the river on vegetation. The other specimens were found along the Sungei Petuang (250 m), on the rocky river banks and up to 5 m from the water and 2 m above ground on shrubs. The ♂♂ all have nuptial asperities and the females are gravid or have convoluted oviducts.

Rana kuhli

Rana kuhlii Duméril and Bibron, 1841.

MATERIAL. BM. 1974. 4641–4654 (2 ♂♂, 4 ♀♀, 8 immature and larvae).

HABITAT. *Rana kuhli* was found only on the east ridge of G. Lawit (790 m) where it occupied small, rocky, mountain streams. Most specimens were found in shallow gravel-bottomed pools along the streams. Some were caught in a side pool of clear water with a light layer of silt and decomposing leaves. Two larvae were caught in a similar pool.

REMARKS. The 2 males have nuptial pads on the first finger covered with minute, white spicules. They have small unpigmented testes and are 61.4 and 93.0 mm in length. Only the larger male has significantly enlarged mandibular processes, which are 3–4 mm in height. Four gravid females are 66.0–81.3 mm in length. The mature ova are one-third pigmented and about 2.5 mm in diameter.

The larvae have I: 1–1 / 1–1: II labial teeth, all the toes broadly webbed to the tips, the tibiae strongly tuberculate and the tail blotched and barred with black. They differ from Bornean larvae, however, in having acutely pointed tails twice as long as the body and in having 3 rows of papillae on the lower lip.

Rana laticeps

Rana laticeps Boulenger, 1882.

MATERIAL. BM. 1974. 4655–4702 (7 ♂♂, 5 gravid ♀♀, immature specimens).

HABITAT. As previously mentioned, this species and *Amolops larutensis* were the only frogs collected at all camps 43–1280 m. These records seem to extend both the upper and lower altitude limits slightly. In Borneo specimens come from 100 to 920 m. In the Malay Peninsula previous records are from 900 to 1220 m.

At the Kelebang *R. laticeps* could only be found in one stream and only four specimens, all caught on the same night, were found, despite frequent collecting both at night and in the day. This was the same rocky hillside stream in which *Amolops larutensis* and *Ansonia* sp. were found. The frogs were in shallow pools or between rocks at the stream edge.

Thirty-nine of these frogs came from two streams on the east ridge of G. Lawit (790 m). The species was found in areas of shallow gravel-bottomed pools and in shallow reaches with many dead leaves and some other detritus in the upper parts of the streams. During the night many

were found in the water, from which the males seem to call. They were also found on the banks, mostly near the water but up to 2 m away in a few cases. During daylight the frogs hide among dead leaves in the water, in crevices under boulders and among the leaf litter along the banks. Juveniles were found in daylight among the leaf mould in seepages along the banks.

Only 2 specimens came from the summit ridge (1280 m). Both were in the small, semi-stagnant stream under closed canopy forest, along which most of the collecting was conducted. One was resting on matted roots in the edge of a pool between rocks, the other was in a shallow pool on a smooth rock base. A few calls were also heard along this stream.

Thus *R. laticeps* occupies a similar habitat throughout its altitudinal range. Apparently it also occupies a very similar habitat in Borneo (Inger, 1966).

REMARKS. The adult males are 34.5–46.9 mm (mean 43.8 mm, N=7) in snout-vent length. Gravid females are 36.7–45.0 mm long (mean 40.8 mm, N=5) and contain ova 2.8–3.0 mm in diameter, with only about one-fifth of the surface pigmented. The ova are therefore larger and less pigmented than those of *kuhli*. The call is a rising gurgle (Fig. 7).

Rana limnocharis limnocharis

Rana limnocharis Boie in Weigmann, 1835.

MATERIAL. BM. 1974. 4703–4724 (15 ♂♂, 4 ♀♀, 2 juveniles, larvae).

HABITAT. This commensal species was found only along logging tracks and in the camp clearing at the Sungei Kelebang (43 m).

Rana luctuosa

Limnodytes luctuosus Peters, 1871.

MATERIAL. BM. 1974. 4725–4726 (two larval series).

HABITAT. One series was collected in forest on the east ridge of G. Lawit at 790 m. The larvae were in a shallow gravelly pool separated from a small stream by two to three metres. The pool bottom was largely covered by a layer of decomposing leaves, with a little silt. At one end an inlet trickle had excavated a deeper hollow between roots. On each occasion on which the pool was approached tadpoles were seen to swim rapidly across it and disappear into this hollow. The other larvae were found in an exposed pool among long grass and *Melostoma* bushes in a boggy padang on the summit ridge at c. 1350 m. This very shallow pool was stagnant and had a deep mud base.

COLOUR. Very dark brown above and dark grey below. Ochre speckling on both dorsum and venter, on tail muscle and upper fin of tail.

REMARKS. The two series differ in the number and length of the papillae on the lower lip, but are otherwise very similar. Specimens from the summit ridge are in stages I–II (Taylor and Kollros, 1946), 12.0–18.0 mm in body length and 18.3–27.0 mm in tail length. Most have labial tooth formulae of I: 3–3 / 1–1 : III but one has I: 4–4 / 1–1 : III labial teeth. Most of the east ridge specimens are also in stages I–II. They have I: 4–4 / 1–1 : III labial teeth generally, although the posterior tooth row is very small in the smaller specimens. They are 15.2–19.5 mm in body length and 24.0–29.5 mm in tail length. A stage XIV larva is little different. It is 24.0 mm in body length, 32.5 mm in tail length and has I: 5–5 / 1–1 : III labial tooth rows. The east ridge specimens have one to three rows of papillae on the posterior lip and the posterior papillae are less than 0.3 mm in length. Summit ridge larvae have two rows of papillae. Alternate papillae of the lower row are greatly elongated, about 0.5 mm in length. Other Malayan larvae of stages I–XIX, with body lengths of 18.0–24.0 mm, and from 275 to 670 m elevation, have elongate papillae 0.4–0.6 mm in length, in proportion to their body lengths.

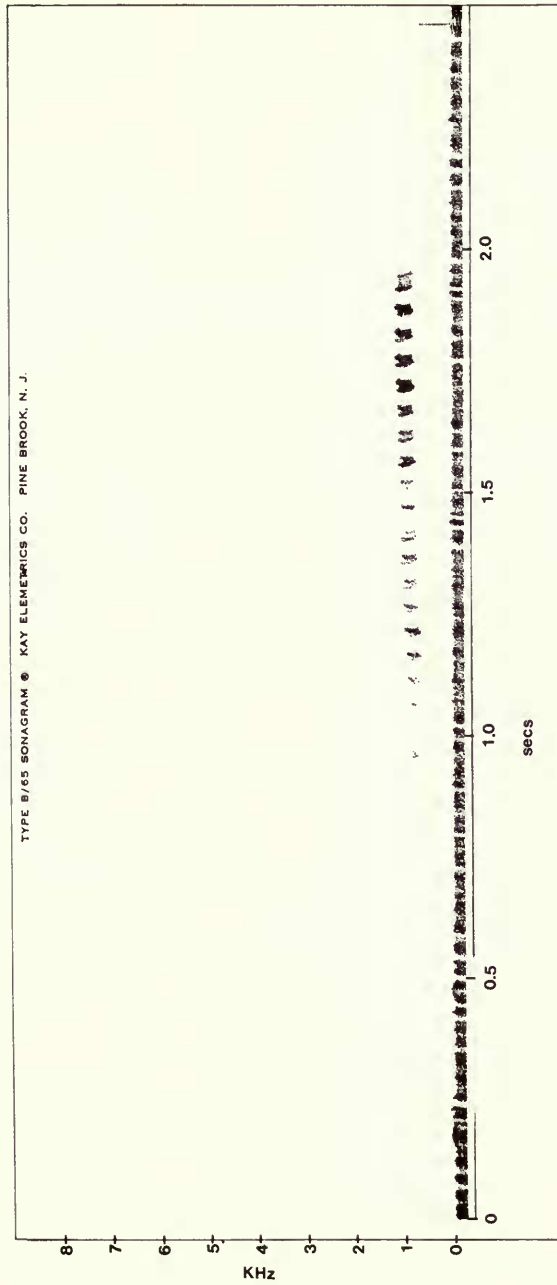


Fig. 7 Sonagram of the mating call of *Rana laticeps*, recorded at 790 m elevation.

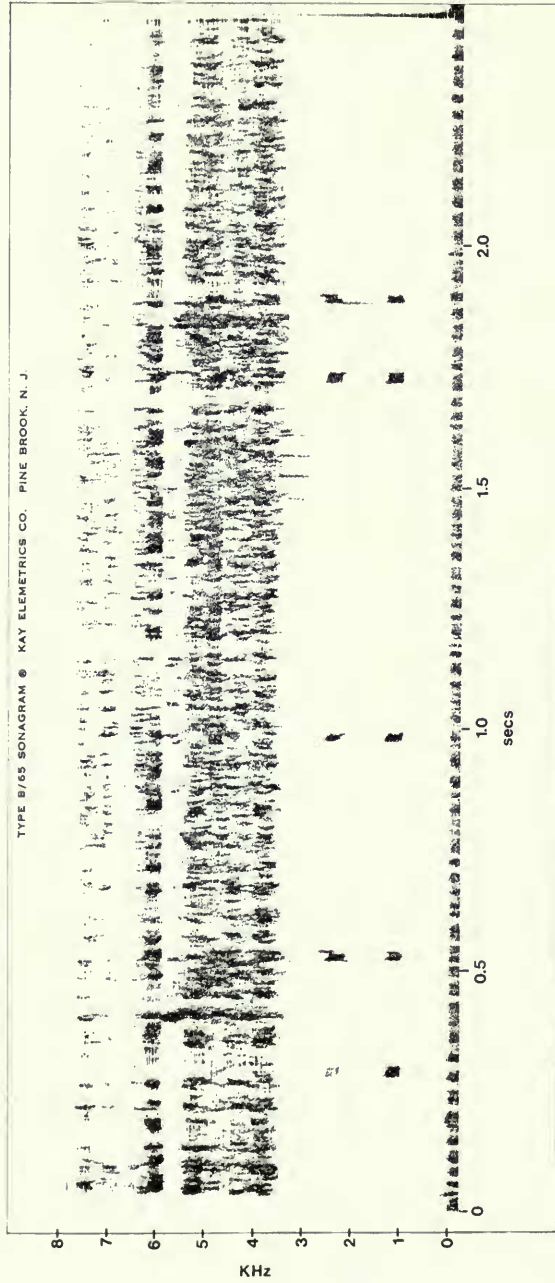


Fig. 8 Sonagram of the mating call of *Rana limnocharis*, most high frequency noise is background.

Rana macrodon

Rana macrodon Kuhl in Duméril and Bibron, 1841.

MATERIAL. BM. 1974. 4727–4728 (immature).

HABITAT. One specimen was caught in a flooded rut on a logging track, the other was caught shortly afterwards on the forest floor, between the buttresses of a tree. The second specimen ducked its head protectively between its fore limbs when approached. Both were collected in the Sungei Kelebang camp area (43 m).

COLOUR. The dorsum is medium brown with some yellowish paravertebral areas. There is some dark dorsal speckling, particularly at the edges of the weak dorsal tubercles. Anterior to the interocular bar the snout was fawn. There is a grey edged, fawn triangle below the eye and an oblique pinkish yellow band from the eye to the arm insertion. The black supratympanic stripe is narrow and covers the upper half of the tympanum, except its centre. The throat is mottled with grey, except where there is a broken median white stripe. The remainder of the venter is white with grey speckling. The hidden surfaces of the limbs are grey; the dorsal surfaces, including the outer two fingers and outer three toes, are the same brown as the dorsum. The posterior thigh is finely mottled with pale brown.

REMARKS. Kiew (1974) gives this species a new name, according to Berry (1975), but since I have not seen this thesis I prefer to use *macrodon*, *sensu* Inger. Berry gives a long list of Malay Peninsula records but without distinguishing between *R. macrodon* and *R. blythi*. The BM(NH) specimens of *R. macrodon* come from Singapore, from Kuala Teku, Pahang and from the Sungai Kelebang, in the Malay Peninsula. The Kelebang specimens, at 5° 28" north, are thus the northernmost I have seen and with Inger's (1966) record from Selinsing, 4° 53" north in Perak they mark the northern boundary of this species on the mainland.

Rana paramacrodon paramacrodon

Rana paramacrodon Inger, 1966.

MATERIAL. BM. 1974. 4729–4732 (3 gravid and 1 immature ♀♀).

HABITAT. The 4 specimens were believed to be *R. blythi* when collected and there are only brief field notes for them. Apparently all were collected in the same areas around the Sungai Kelebang in which *R. blythi* were found. Two were collected along the Sungai Kelebang, one of them while hiding among leaf litter by a shallow muddy side pool. Another was collected by one of the logging tracks, probably from a pair of very shallow clay-based trackside pools. The fourth was by a stream pool in a swampy area.

REMARKS. They agree closely with a paratopotype of *R. p. paramacrodon*. They range in size from 38.3 to 56.6 mm and the largest specimen contains enlarged pigmented ova. They have tibia to snout-vent length ratios of 0.537–0.575 and head length to snout-vent ratios of 0.364–0.373. The distal two phalanges of the fourth toe have a broad fringe of webbing on each side, such as is found in Bornean *paramacrodon*. On the inner edges of the second and third toes the web reaches the digit tips as a narrow sheet. All the frogs are a rather uniform dark brown dorsally, without a vertebral stripe, and all have a narrow light line along the thigh but not on the tibia. None has the distinct dorsal ridges found in some Bornean *paramacrodon*. There is a well-defined, lozenge-shaped, black tympanic mask. The entire surface of the throat is covered by fine grey mottling.

Kiew (1972) recorded *R. paramacrodon* from Tasek Bera, Pahang, and various localities in Selangor, although he noted that his frogs might represent an undescribed species. The specimens showed several distinctive features of *paramacrodon*, such as their small size and yellow ventral coloration. However, they lacked the equally distinctive black tympanic mask. This, then, is the first definite record of *paramacrodon* from the Malay Peninsula.

Rana plicatella

Rana plicatella Stoliczka, 1873.

MATERIAL. BM. 1974. 4733 (♂).

HABITAT. The frog was taken at night from a small stream on the east ridge of G. Lawit (790 m).

COLOUR. Dorsum dark ochre with blackish crossbars on the limbs. Throat white mottled with pale grey around the jaws. Chest, abdomen, undersurfaces of thigh and tibia golden yellow, speckled with brown on the distal femur and tibia.

Rana signata signata

Polypedates signatus Günther, 1872.

MATERIAL. BM. 1974. 4734–4757 (19 ♂♂, 5 ♀♀).

HABITAT. This common frog calls at night from tangles of roots and sticks up to 2 m from river edges. Its distinctive coloration makes it extremely difficult to see in such situations. Frogs were collected from this sort of site at both the Kelebang and the Petuang. At the Kelebang some males were also found by small streams in clearings or in forest. One of the females was found at a trackside about 100 m from the Kelebang, the others were in the same situations as the males. The call is shown in Fig. 9.

Rana tweediei

Rana tweediei Smith, 1935b.

MATERIAL. BM. 1974. 4758–4759 (immature).

HABITAT. Both were found on the forest floor away from streams. One was found during the afternoon on a dry ridge top track at about 600 m on the east ridge of G. Lawit. The other hopped across a trail at about 300 m on Bukit Bok, during a rainy afternoon.

COLOUR. The dorsal surfaces were reddish to dark brown with dark paravertebral blotches and narrow dark crossbars on the limbs. The larger specimen had a broad pale pinkish vertebral stripe from snout tip to vent. There was a ragged dark supratympanic marking and an orange pink oblique stripe behind the eye covering the lower edge of the tympanum. The lips have dark crossbars. The throat was colourless, the chest and abdomen pale yellow and the undersurfaces of the thigh and tibia yellow orange.

REMARKS. These two specimens, 30 and 21 mm in length, are virtually identical with two immature frogs from Pulau Tioman called by Hendrickson (1966) *Rana (Discodeles/Platymantis)* sp. There are small discs on the fingers and toes which have anterolateral grooves partly separating the dorsal and ventral surfaces. The dorsal portion of the disc, generally shorter than the ventral portion, is further subdivided by a median groove. I believe that these grooves are due to desiccation of the digit tips; similar structures can be seen on the discs of some preserved *Rana hascheana*, *microdisca* and *tweediei*. The finger discs are not wider than the basal portion of the digit, the first finger is short, the toe webbing is reduced, the outer metatarsals are separated in the distal part by web, the tympanum is distinct, there are weak dorsolateral glandular folds and the omosternum is deeply forked at the base. These characters, and their general appearance, place the specimens in the *ranae grunnientes* of Boulenger (1920), and close to *hascheana*, *microdisca*, *nitida* and *tweediei*. Their webbing is more extensive than that of *R. hascheana*, but is identical with that of the other species.

Rana tweediei Smith, which may be the Malay Peninsula representative of the *microdisca* group, was placed in the synonymy of *R. nitida* Smedley, 1931, by Kiew (1975) who showed that they do not differ in relative head or body proportions. Kiew noted the difference in size between his specimens of *tweediei* and the holotype of *nitida*, but did not consider it of specific value. Four fully adult males of *tweediei* in the BM(NH) are 36.5–41.8 mm in length (mean 39.4 mm). These

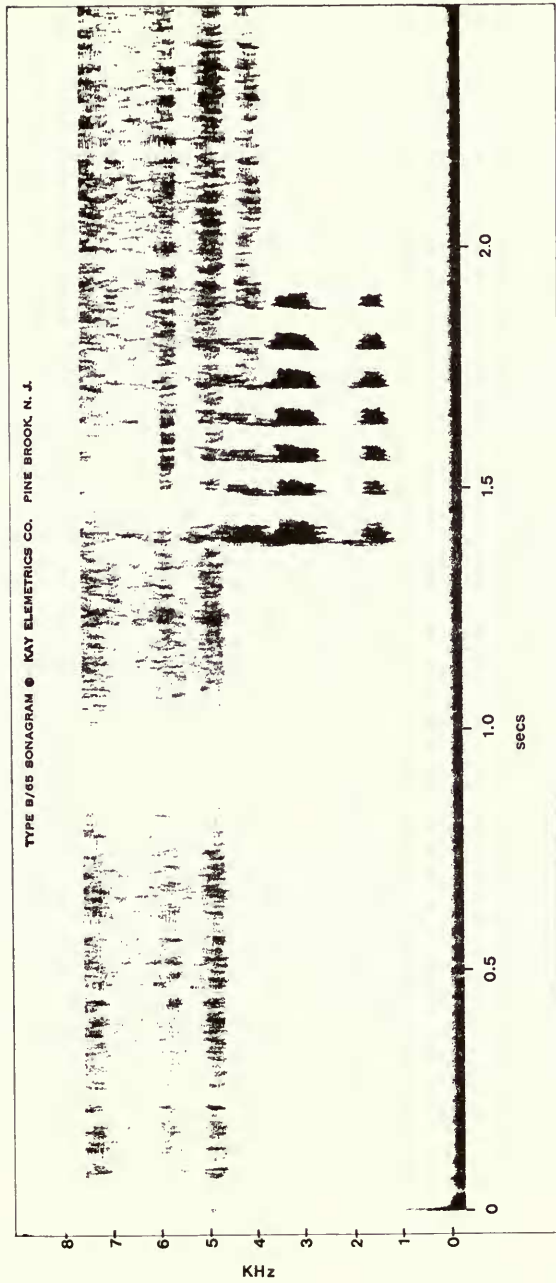


Fig. 9 Sonogram of the mating call of *Rana signata*, recorded at 43 m elevation. Most high frequency noise is background.

have enlarged heads and elongated mandibular processes, which in the largest specimen are 1.2 mm in height. This specimen has compact, unpigmented, rather rounded testes 3 mm in length. The male paratype of *nitida* is 53.5 mm in length, has short mandibular processes only 1 mm in height, and very large, compact, unpigmented and rather elongate testes 9.4 mm in length. Three gravid females of *tweediei* are 37.8–41.8 mm long (mean 39.8 mm), the gravid female holotype of *nitida* is 71.0 mm in length. Thus *tweediei* not only differs from *nitida* very markedly in size but may differ in male secondary sexual characters; and should be reinstated as a distinct species. One characteristic of *tweediei* is a jagged white (in preservative) stripe running from the eye over the lower edge of the tympanum. Since the Trengganu specimens share this characteristic, and since they were found within the known altitudinal range of *tweediei* (in lowlands up to 800–900 m) I refer them to this species, not to *nitida* which has only been found at 1370 m.

Family RHACOPHORIDAE

Edwardtayloria picta picta

Ixalus pictus Peters, 1871.

MATERIAL. BM. 1974. 4761 (gravid ♀).

HABITAT. From the east ridge of G. Lawit at 790 m. It was caught at night 2 m above the bank of a stream on a dead *Pinanga* stem.

COLOUR. The dorsum is cinnamon with creamy yellow spots. The discs of the first and second fingers and first to third toes are creamy yellow, the others are cinnamon. The throat and the undersurfaces of the fore limbs are yellowish with small cream speckles. The undersurfaces of the hind limbs are a light cinnamon. The belly is black with chalk white marbling. The iris is cinnamon, except for the upper anterior third which is cream.

REMARKS. This frog belongs to the genus, previously called *Hazelia* (see Liem, 1970), for which the new name *Edwardtayloria* was erected by Marx (1975), *Hazelia* being pre-occupied.

Philautus aurifasciatus

Hyla aurifasciata Schlegel, 1837.

MATERIAL. BM. 1974. 4762–4780 (14 ♂♂, 3 ♀♀ and 2 immature).

HABITAT. On the east ridge of G. Lawit (790 m) specimens were caught from $\frac{1}{2}$ to 4 m above the ground on shrubs, along streams and on the hillsides above them. On the summit ridge at 1280 m 7 specimens were caught in closed canopy forest in the humid valley of a small stream. The species was also common at the summit (1500 m), where males were found calling from low foliage at night. There was no accessible ground water at the summit but in shallow valleys dry silty runnels among the leaf litter showed that during heavy rain there was some transitory surface water. These conditions must greatly favour frogs with direct development. *P. aurifasciatus* was never found in tree holes on G. Lawit, and was not collected in the heathy padang where *Nepenthes* grew.

REMARKS. This species has a number of characteristics that distinguish it from other Malay Peninsula species. The size does not show much geographic variation. Mature males have the following snout-vent lengths; G. Lawit, 21.9–26.9 mm (mean 24.1 mm, N=14); G. Benom, 20.6–26.2 mm (mean 23.8 mm, N=25); Borneo, 15.8–24.0 mm (mean 21.78 mm, N=13). Females with eggs or convoluted oviducts are considerably larger; G. Lawit, 27.8–31.7 mm (mean 29.7 mm, N=3); G. Benom, 31.0–36.7 mm (mean 33.7, N=7); Borneo, 23.9–33.3 mm (mean 29.9 mm, N=13). Data for Bornean specimens are from Inger (1966). Lingual papillae are generally present. Mature males have colourless nuptial pads on the dorsomedian surface of the first metacarpal. They have vocal sac slits which are generally small and near the jaw commissure. The gular skin is moderately folded to allow for extension of the vocal sac. Almost

invariably adult males have weakly conical snout tips, while adult females have strongly conical ones. *P. aurifasciatus* is a strictly Sundan species and BM(NH) examples come from only as far north as the Larut Hills and G. Lawit.

Smith (1930) incorrectly reported this species from Thailand and Cambodia. Re-examination of his specimens shows that they have the characters below. A small species. 8 mature males from Changwat Tak are 16.7–20.3 mm in length (mean 19.2 mm). A female with kinked oviducts from north Thailand is 17.0 mm in length and 2 females with convoluted oviducts from south Cambodia are 19.0 and 19.4 mm long. Mature males have elongate vocal sac slits which reach forwards to about the middle of each mandible. The gular skin is massively folded to accommodate what must be a relatively large vocal sac. Lingual papillae are absent in all 37 specimens. There are nuptial pads like those of *aurifasciatus* and the snout shape is similar. Taylor (1962) collected a small *Philautus* in north Thailand which he called *P. parvulus* (Boulenger). I have compared Smith's material with two of the types of this species; the name *parvulus* appears to be applicable to these populations. The range of the species may extend south into the Malay Peninsula. *Philautus* have been collected in peninsular Thailand on Khao Luang and Ronpibun Hill, Nakhon Si Thannarat, and on Bukit Besar and at 'Patani' in the south east. Ten specimens from these localities all lack lingual papillae. Two mature males from 'Patani' and one of two from Ronpibun Hill have massively folded gular skin like *parvulus*. Snout-vent lengths of the 4 males are 18.5–21.2 mm (mean 19.6 mm). Immature specimens from Khao Luang and Bukit Besar have a pattern which includes a midventral pale line on the gular region (see Boulenger, 1903). All these specimens are tentatively referred to *P. parvulus*.

LARVAE. The breeding behaviour of *Philautus* is still poorly known. The ova are large and few (see Inger, 1966). This has led to hypotheses that the ova are deposited out of water. The Wolffian duct is simple, which suggests that no foam nest is produced (see Liem, 1970). *P. aurifasciatus* was observed by Mjoberg to lay its eggs in *Nepenthes* pitchers on G. Murud (Smith, 1925a). Frogs of the genus are frequently found calling far from water. Inger (1966) artificially fertilized eggs of *P. hosei* and raised larvae which developed to limb bud stage within the vitelline membrane. These larvae lack structures necessary for an active life (the horny beak, expanded lips, labial teeth, external gills, operculum and coiled gut) but have a very large yolk mass.

Larvae (BM. 1914. 5.12.3–17) were collected from *Nepenthes* pitchers on the summit of G. Santubong, Sarawak, and raised from pre-limb-bud state to metamorphosis. They were subsequently identified as *P. petersi* (= *aurifasciatus*) on the basis of the juveniles. These larvae agree with Inger's description of *P. hosei* larvae, except that the tail fins are well developed and highly vascularized, probably for respiration. According to the collector's notes, they did not leave the egg membranes until metamorphosis. Another series was collected from moss on tree trunks at 1280 m on G. Bunga Buah, Selangor, and discussed by Berry (1975) as *Megophrys longipes*. These agree closely with the Santubong larvae except that the tail fins are a little less well developed and not obviously vascularized. Neither series has the usual larval mouth parts or coiled gut, neither do they have external gills or an operculum with a spiracle. The eyes are well developed, there are olfactory pits, the fore and hind limb buds develop synchronously and there is a large yolk mass. *P. vermiculatus* males have also been collected among moss on tree trunks at this altitude on G. Bunga Buah. These larvae are reminiscent of those of *Rhacophorus nicrotympanum* (generic status uncertain according to Liem) described by Kirtisinghe (1946), which have an operculum and spiracle and non-functional gills.

A number of previous records of *Philautus* larvae have been based on aquatic larvae (Annandale, 1913, 1918, 1919; Rao, 1937; Roonwal and Kripalani, 1961; Smith, 1924, 1953). I have seen only the larvae assigned to *P. romeri* Smith (1953). They have I: 2–3 / III labial tooth rows and their characteristics, including extent of toe webbing and the size of the discs on the fingers and toes, support Smith's identification. Smith compared this species with *Chirixalus laevis*, belonging to a genus which has aquatic larvae with similar labial tooth row formulae. However, to me *P. romeri* does not appear similar to species currently assigned to *Chirixalus*, but to small *Philautus* species such as *P. amandalei*. Annandale (1913) recorded larvae which he assigned to *annandalei*. According to his account, they resembled *Polypedates leucomystax* larvae, and so should have

had I: 3-3 / 1-1 : II labial teeth. The other records are less satisfactory. The supposed larvae of *P. variabilis* described by Annandale (1918, 1919) had II: 5-5 / 1-1 : V labial tooth rows, a higher number than is known in any other rhacophorid frog. Smith (1924) assigned larvae to *P. gryllus* but without giving his reasons. The larvae did not come from the same locality as his adults and had tooth row formulae of II: 3-3 or 4-4 / 1-1 : III. This formula is like that of *Chirixalus*, two species of which were found at nearby localities. Rao described larvae from 'streams of Kempholey' which he thought belonged to *P. hypomelas*, *P. leucorhincus*, *P. nassutus*, *P. pulcher* and *P. variabilis*. These appear from his description and plate to be generally stream adapted; they have somewhat expanded lips which lack labial teeth although a beak is present. The lips of some are multilobate. These larvae are unlike any yet known from the *Rhacophoridae*, but are similar to those described by Annandale (1918, 1919) and assigned to *Rana leptodactyla*, *Rana semipalmata* and *Nyctibatrachus*. Roonwal and Kripalani described a new species of *Philautus* from Assam on the basis of larvae and a juvenile. This species has webbing between the fingers, unlike any species assigned by Liem to *Philautus*. The finger webbing is however approximately as extensive as that in *Rhacophorus taronensis* Smith, from northern Burma. In summary, records of aquatic larvae for *Philautus* are suspect. They are probably based mainly on misidentifications, while some supposed *Philautus* may belong to other genera.

COLOUR. There is dorsal polychromatism as described by Grandison (1972). The ground colour of the dorsal surfaces varies from pinkish fawn to dark brown. The lips are cream spotted and the throat is mottled with grey and brown. The belly is greyish brown. The posterior flanks and anterior and posterior faces of the thigh are claret brown with oval fawn blotches. The iris was described in the field as gold to dark brown, and is never grey.

Philautus vermiculatus

Ixalus vermiculatus Boulenger, 1900.

MATERIAL. BM. 1974. 4781-4821 (30 ♂♂, 2 ♀♀, 8 immature).

HABITAT. This Malay Peninsula endemic has the same altitudinal distribution as the more widespread *P. aurifasciatus*, it is known from 790 to 1530 m. Three specimens were taken at night from leaves 2-5 m above the forest floor on the east ridge of G. Lawit (790 m). One of them was calling from the top of a small tree on the steep valley side above a stream. Thirty specimens were caught around the summit ridge camp (1280 m). Half (12) of those with data were caught on leaves at night. Eight were taken from tree holes, holes in hollow branches, mostly at night. Males were found calling from both leaves and tree holes. The species was found equally in closed canopy forest in a humid stream valley (6) and in a nearby grassy padang (6). During a few hours' collecting in closed canopy forest at the summit 7 examples were obtained from low vegetation. Of the 6 caught there at night 4 males were calling from tree holes, another male was on a leaf near one of these calling males and a gravid female was caught a metre from another of the calling males.

It is possible that *P. vermiculatus* lays its eggs in tree holes and that males lead gravid females to these holes by calling. No clear ecological separation of *vermiculatus* and *aurifasciatus* was noticed in the field, but *aurifasciatus* was never found in tree holes or collected in a padang. It would be interesting to see whether the different colours of the two species lead to different choices of substrate. More precise observations need to be made before the mechanism by which these two similar species occupy the same areas can be understood. The quacking call is shown in Fig. 10.

COLOUR. In alcohol the 3 specimens from the east ridge are like all the BM(NH) examples of *vermiculatus* from other localities (the main range, G. Benom and G. Tahan, and from throughout the altitudinal range) in having the anterior and posterior faces of the thigh unpigmented. However, all the specimens from the summit and summit ridge have these areas darkly pigmented. From the field notes it appears that there were also differences in the life colours of the higher and lower populations on Lawit.

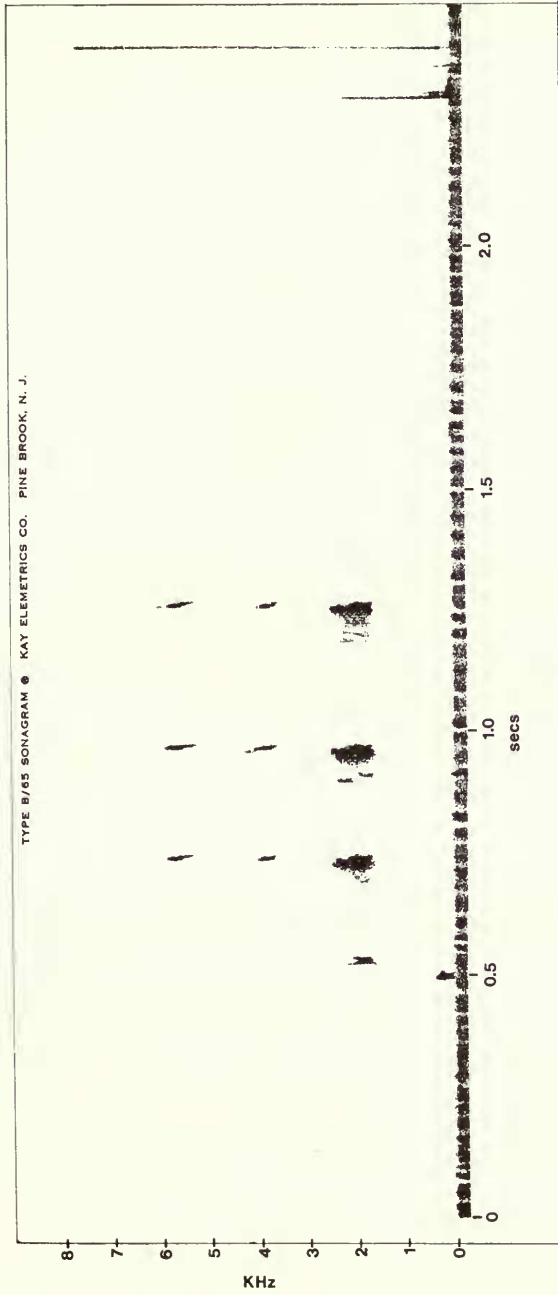


Fig. 10 Sonagram of the mating call of *Philautus vermiculatus*, recorded at 790 m elevation.

East ridge sample. Dorsal surfaces yellow brown to lichen green with darker vermiculations and other markings. Throat lemon yellow to fawn, mottled with brown. Other ventral surfaces and hidden surfaces of limbs golden yellow to orange. Lips cream spotted. Iris silver grey.

Summit and summit ridge sample. Throat creamish, belly greyish or colourless. Anterior and posterior faces of thigh pale ochre to medium brown. Dorsal surfaces and iris as above.

REMARKS. This species can be easily recognized in the field by its characteristic head shape (Grandison, 1972) and by its colour. *P. aurifasciatus* always lacks the greenish dorsal and yellowish ventral colours of *vermiculatus*. The iris is brown in *aurifasciatus*, silver in *vermiculatus*. This species shows only weak dorsal polychromatism compared to *aurifasciatus*. There is usually an hour-glass-shaped figure on the anterior dorsum sending back branches to the groin. Some *aurifasciatus* patterns are similar. *P. vermiculatus* invariably lacks a conical tip to the snout and a lingual papilla. Nuptial pads are also absent. In addition *vermiculatus* reaches a slightly larger size and has a relatively shorter tibia and narrower head. These differences are shown in Table 2.

Table 2 Data on West Malaysian *Philautus* (lengths in mm)

	<i>P. vermiculatus</i>	<i>P. aurifasciatus</i>
SV ♂♂	25.3–29.4 (mean 27.3, N=30)	20.6–26.9 (mean 23.9, N=39)
SV ♀♀	32.8–36.9 (mean 35.4, N=3)	27.8–36.7 (mean 32.4, N=10)
Tibia/SV	0.472–0.547 (mean 0.505, N=9)	0.515–0.603 (mean 0.562, N=9)
HW/SV	0.382–0.418 (mean 0.404, N=9)	0.412–0.438 (mean 0.427, N=9)

Polypedates colleti

Rhacophorus colleti Boulenger, 1890.

MATERIAL. BM. 1974. 4821–4823 (3 ♂♂).

HABITAT. All were collected on the same night, 1½–3 m above the ground on bushes and saplings around the edge of a swampy area in logged forest near the Sungei Kelebang camp (43 m).

COLOUR. By day the dorsum varied from pinkish grey to pale reddish chocolate. There was a darker hour-glass figure on the mid-dorsum surrounded by scattered dark and light speckling. The lip was dark edged with a pale line above. There were similar pale lines with dark lower edges on the outer surfaces of the limbs and the outer finger and toe, and above the vent. The throat was greyish, and the belly yellowish white. There are white tubercles below the vent. The iris was very pale brown.

REMARKS. Liem (1970) placed this species, along with *leucomystax*, *macrotis* and nine other species, in the revived genus *Polypedates*.

Polypedates leucomystax leucomystax

Hyla leucomystax Boie in Gravenhorst, 1829.

MATERIAL. BM. 1974. 4824–4835 (9 ♂♂, 1 gravid ♀, larvae).

HABITAT. On tracks or in secondary trackside vegetation in logged forest at the Sungei Kelebang.

Polypedates macrotis

Rhacophorus macrotis Boulenger, 1891a.

MATERIAL. BM. 1974. 4836 (♂).

HABITAT. It was caught at night 1½ m above the ground on a stem by a logging track at the Sungei Kelebang.

Rhacophorus appendiculatus

Polypedates appendiculatus Günther, 1858.

MATERIAL. BM. 1974. 4837–4845 (9 ♂♂).

HABITAT. All were collected in the disturbed areas around the Sungei Kelebang (43 m). Six were found in a dense thicket of saplings and other shrubs, rattan and vines at the intersection of two logging tracks. A large tree stump had been uprooted leaving a shallow, partly shaded hollow. This had flooded and a chorus of males were found around it on two successive nights. They were calling from 30 to 100 cm above ground level on shrubs. The other three specimens were caught in a similar, disturbed and swampy area. A moderately thick growth of rattan, ginger, banana and other shrubs had grown up where the larger forest trees had been removed. The swampy ground was criss-crossed with logs and covered by a network of very shallow pools. The frogs were on vegetation and 60–200 cm above ground level.

COLOUR. The dorsal surfaces are dark green to brown, with a dark interocular bar and hour glass figure on the abdomen. One specimen had russet dorsolateral markings. Throat is yellowish to greenish and may be colourless posteriorly. The belly is yellowish to dull orange. The anterior face of the thigh is brown to dark brownish red and the posterior face is dark blood red. The supra-anal scallops, the scalloped margin of the tarsus and fifth toe are white and there are white spots around the vent. The iris is sandy brown, orangey above.

REMARKS. The generic status of this species is uncertain (Liem, 1970). It is *Philautus*-like in appearance but has an aquatic larva. These males are similar in size to those from Sandakan, Sabah (Inger, 1966). Snout–vent length is 29.7–34.4 mm (mean 31.9 mm). Tibia length relative to snout–vent length is 0.489–0.532 (mean 0.505). Three males from Selangor and Negeri Sembilan are similar in size (mean 31.3 mm) and 2 Pahang females are 43.8 and 48.1 mm in length.

The call is shown in Fig. 11.

Rhacophorus bimaculatus

Leptomantis bimaculatus Peters, 1867.

MATERIAL. BM. 1974. 4846–4851 (3 ♂♂, 3 gravid ♀♀).

HABITAT. A male and 2 gravid females were caught in a bare and partly flooded logging clearing near the Sungei Kelebang camp, through which a fast deep affluent stream of the Kelebang was running. The male was above the stream surface on a pandan and the females were 1½–2 m up on shrubs of the clearing edge. Males, heard calling from undisturbed riverbank vegetation at the Sungei Petuang (250 m), were 1–2½ m above the steep rocky banks on shrubs and small trees. A gravid female was a metre above the river edge on a fern.

COLOUR. The dorsal surfaces are sandy to dark brown with five darker bars, on the interocular area, on the nape, the anterior dorsum, the sacrum and just anterior to the groin. The sacral bar is generally broken up into two dark patches over the sacral hypophyses. There is a conspicuous white spot below the posterior half of the eye. The lower jaw is brown edged, the venter is otherwise white. The posterior part of the flanks, the goin, the anterior and posterior faces of the thigh are dark brown with sky blue spots. There is some sky blue speckling on the ventral surface of the tibia, on the inner edge of the tarsus and foot, and in the axilla.

REMARKS. Liem (1970) examined the musculature and other characters of *R. bimaculatus* Boulenger, *R. bipunctatus* Ahl and *R. zamboangensis* (Taylor) separately, according to his appendix. However, *bipunctatus* Ahl is a replacement name for *bimaculatus* Boulenger, preoccupied by *Leptomantis bimaculatus* Peters, and so cannot be a distinct species. Since *bimaculatus* (Peters) appears superficially to be a *Rhacophorus*, and since *zamboangensis* (Taylor) was placed in its synonymy by Inger (1966), it is fair to assume that Liem's *R. bimaculatus* Boulenger was a *lapsus* for *R. bimaculatus* (Peters) and to treat this species as a *Rhacophorus* henceforth. It is found in the southern Philippines, Borneo and the Malay Peninsula.

The call is shown in Fig. 12.

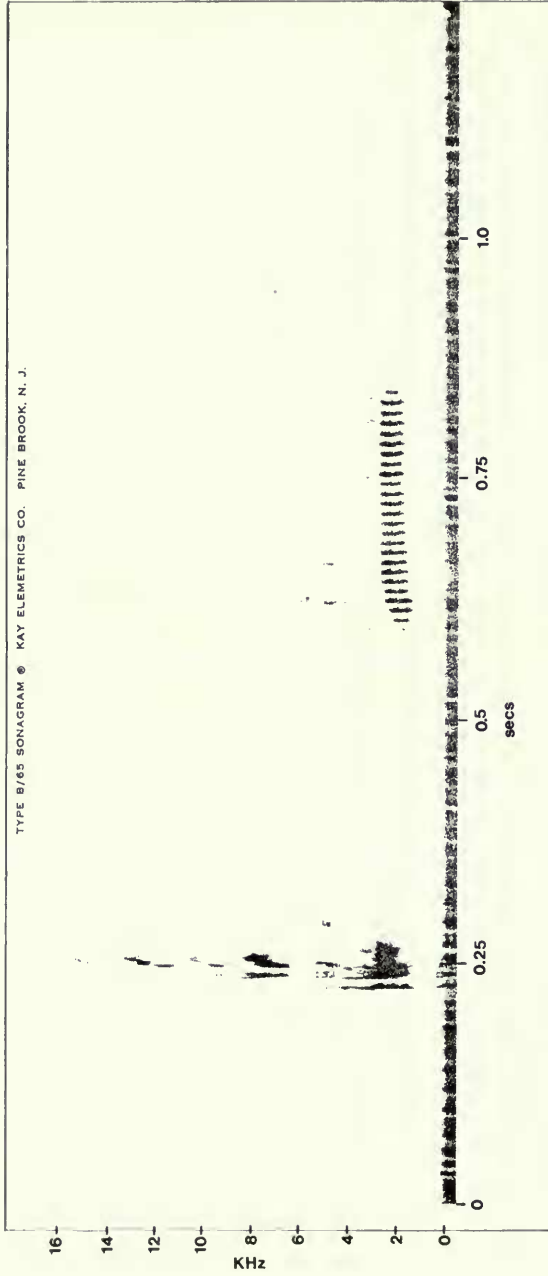


Fig. 11 Sonagram of the mating call of *Rhacophorus appendiculatus*.

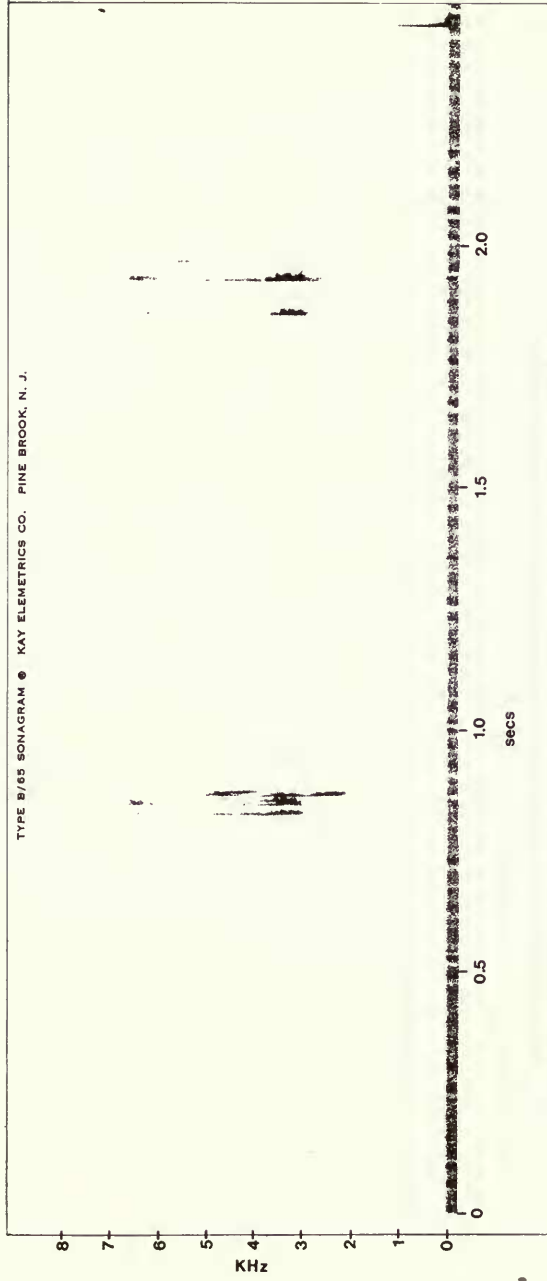


Fig. 12 Sonogram of the mating call of *Rhacophorus bimaculatus*, recorded at 250 m elevation.

Rhacophorus bipunctatus

Rhacophorus bipunctatus Ahl, 1927.

MATERIAL. BM. 1974. 4852–4882 (29 ♂♂, 1 ♀, juvenile and larvae).

HABITAT. Twenty-four of the specimens, including the female, were caught around the streamlet at the summit ridge camp at 1280 m. This small stream occupied a 100-m stretch of gently inclined valley bottom between a dry basin, overgrown with shrubs, and a mossy rockfall leading down into a steeper, drier section incised into the hillside. Collecting was carried out during a time of little rainfall and the only water available was in a series of still, clear rockpools up to $\frac{1}{2}$ m deep. Shortly after the camp was left, however, a heavy rainfall transformed the water course into a torrent. The vegetation was a thick growth of *Licuala*, *Pinanga*, pandan, vines and woody shrubs such as *Melastoma* below a tree canopy at 10–15 m. Males were calling from $\frac{1}{2}$ to 4 m above the ground on vegetation within a few metres of the stream. A pair in axillary amplexus were found on one of the lower branches of a tree, at 3–5 m above a shallow pool, and later laid a foam nest. Near the upper end of the stream bed a dry 'backwater', overgrown with low shrubs, but with several water-filled depressions, was searched. Near the back a shallow, pebble-bottomed pool below the bank contained well-developed larvae. A recently metamorphosed juvenile was found on the shrubs nearby. The other seven specimens were also caught at night, in a padang near the camp, at c. 1350 m. They were calling from shrubs and sedge and $\frac{1}{2}$ –2 m above the ground, at the margin of shallow muddy pools in a high grass area of open *Leptospermum* forest.

COLOUR. The dorsal colour is very changeable, from chestnut to yellow ochre, pale turquoise or even pale bluish grey. There is a slight, fine darker mottling sometimes forming an indistinct hour-glass pattern. The venter is white, or yellowish on the throat and anterior belly of some, and the hidden surfaces of the limbs and flanks are bright yellow, sometimes colourless or fleshy orange. The hand webs and all fingers except the outermost are yellow in males, but were described as pinkish and yellow streaked in the female. The outer toe webs and adjacent parts of those digits that are hidden at rest are a vivid brownish red, the inner webs are lighter. The vent, forearm and heel appendages are white edged. There may be white or cream spots on the dorsum. All specimens have a black or blue-black spot or linked pair of spots on the anterior flanks. The iris is brownish grey with a silver ring round the pupil.

Dorsal surfaces of the larvae are brown, turning golden green in older larvae. Ventral surfaces are colourless, the tail fades to grey distally.

REMARKS. This is the species found from the eastern Himalayas to West Malaysia, originally described by Boulenger (1882) as *R. bimaculatus*, and previously referred to in Malay Peninsula reports by this name. Measurements of Malayan specimens are: snout–vent length of males 37.1–40.0 mm (mean 38.3 mm, N=10), of females 56.1–56.6 mm (N=3); tibia in terms of snout–vent length is 0.466–0.504 (mean 0.483, N=10).

The call is a harsh rattle, and is shown in Fig. 13.

Rhacophorus nigropalmatus

Rhacophorus nigropalmatus Boulenger, 1895.

MATERIAL. BM. 1974.4883–4897 (13 ♂♂, 1 ♀ and eggs).

HABITAT. The males were collected in trackside vegetation, 4–7 m above the ground, at the Sungei Kelebang camp. They were calling softly from trackside bushes throughout the collecting period, mostly in the vicinity of flooded ruts or other pools. The female was found in a torpid condition on felled vegetation in such an area. It spawned while alone in a collecting bag.

Rhacophorus pardalis

Rhacophorus pardalis Günther, 1858.

MATERIAL. BM. 1974. 4898–4904 (4 ♂♂, 2 ♀♀).

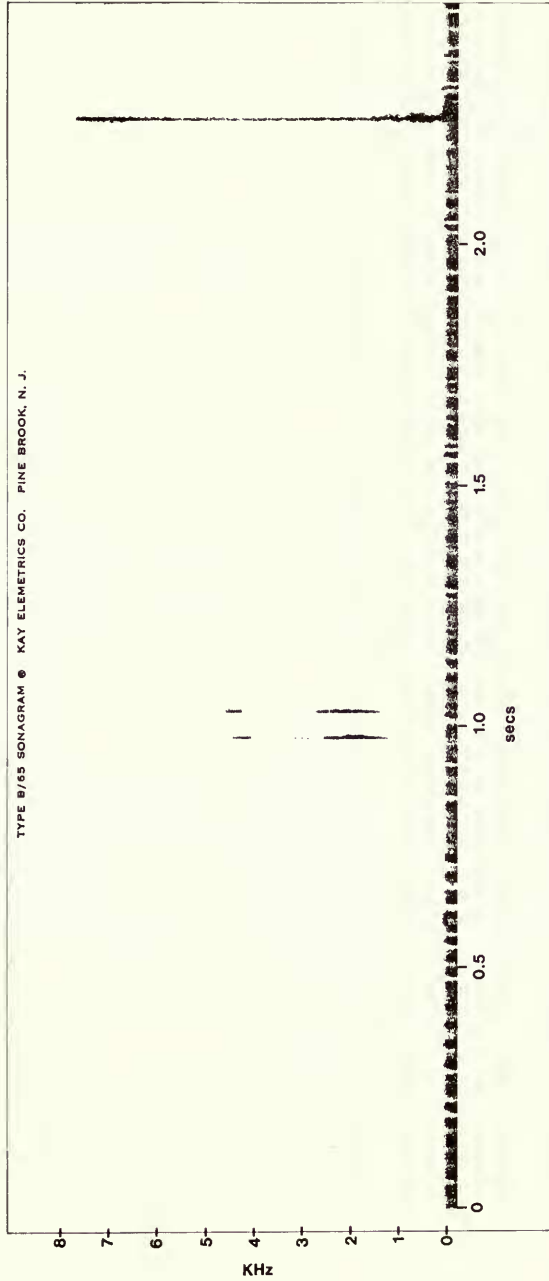


Fig. 13 Sonagram of elements of the mating call of *Rhacophorus bipunctatus*, recorded at 1280 m elevation.

HABITAT. All were collected in the extensively disturbed areas around the Sungei Kelebang camp (43 m). Three males were in thick secondary vegetation at the sides of logging tracks and 2–5 m above the ground. Two were within a few metres of *R. nigropalmatus*, the other was near *R. reinwardti*. A pair in amplexus were traced by the male's call to a tree in a disturbed and swampy area. They were 5–10 m above ground. A gravid female was found in the same area about a metre up on a rattan stem.

COLOUR. Dorsal surfaces pale grey brown to orange brown. Irregular brown or grey markings and black, orange or lavender speckling. Flanks mottled yellow and orange. Belly creamy yellow marbled with orange. Throat whitish to yellow. Hidden surfaces of limbs fleshy orange to sulphur yellow. Webs orange and red. Lavender grey areas above vent and heels, and covering vent and heel appendages. Iris pale brownish grey.

REMARKS. This lowland species which has been recorded from both Sumatra and Borneo was to be expected in the Malay Peninsula, and has also been recorded by Berry (1975) from Selangor. These Kelebang specimens roughly agree in size with Inger's (1966) Sarawak sample. Mature males 46.5–50.1 mm (mean 47.5 mm, N=4) in snout-vent length, the mature females 66.3 and 63.4 mm long.

Rhacophorus cf. *reinwardti*

Hypsiboas reinwardtii Wagler, 1830.

MATERIAL. BM. 1974. 4905–4907 (2 ♂♂, 1 immature ♀).

HABITAT. These frogs came from a short stretch of logging track near the Sungei Kelebang camp at 43 m. They were traced by calls to the secondary trackside vegetation and forest edge where they were found 2, 5 and 7 m up in small trees. *Rhacophorus pardalis* was found at the same stretch of track and called from approximately the same level above ground at a nearby site, while *nigropalmatus* called from the same level at different logging track sites which offered apparently identical conditions.

COLOUR. As described by Grandison (1972).

REMARKS. These specimens, with a male from Kampong Janda Baik, Pahang, and a gravid female from Khao Kala Kiri, extreme southern Thailand, confirm Grandison's description of the differences between the Javan and Malayan populations. Liem's (1973) notes on a Javan population of *reinwardti* show that the flash colours are more like those of *bipunctatus* than like those of the Malayan frogs, while the size of the Javan frogs is intermediate between those of the Malayan population and of *bipunctatus*. Calls and known larvae of the three groups are similar. In the Malay Peninsula '*reinwardti*' (43–c. 550 m) and *bipunctatus* (600–1350 m) are altitudinally separated. In Java *reinwardti* is or was of wide altitudinal distribution according to Liem. When the Sumatran populations are properly known it will probably be found that the specimens noted here represent a distinct species for which no name is yet available, *Rhacophorus reinwardti lateralis* Werner, 1900, being preoccupied by *Rhacophorus lateralis* Boulenger, 1883.

An element of the rattling, woodpecker-like call is shown in Fig. 14.

Theلودerma horridum

Ixalus horridus Boulenger, 1903.

MATERIAL. BM. 1974. 4908 (♂).

HABITAT. The specimen was caught at night in thick secondary trackside vegetation near the Sungei Kelebang at 43 m. It was about 2 m above ground on the rough bark of a large tree. When disturbed it climbed steadily up the trunk.

COLOUR. Dorsum medium brown with indistinct dark markings. Tympanum blackish with a pale rim. Lower flanks, belly and under surfaces of hind limbs pale greenish blue with rounded grey

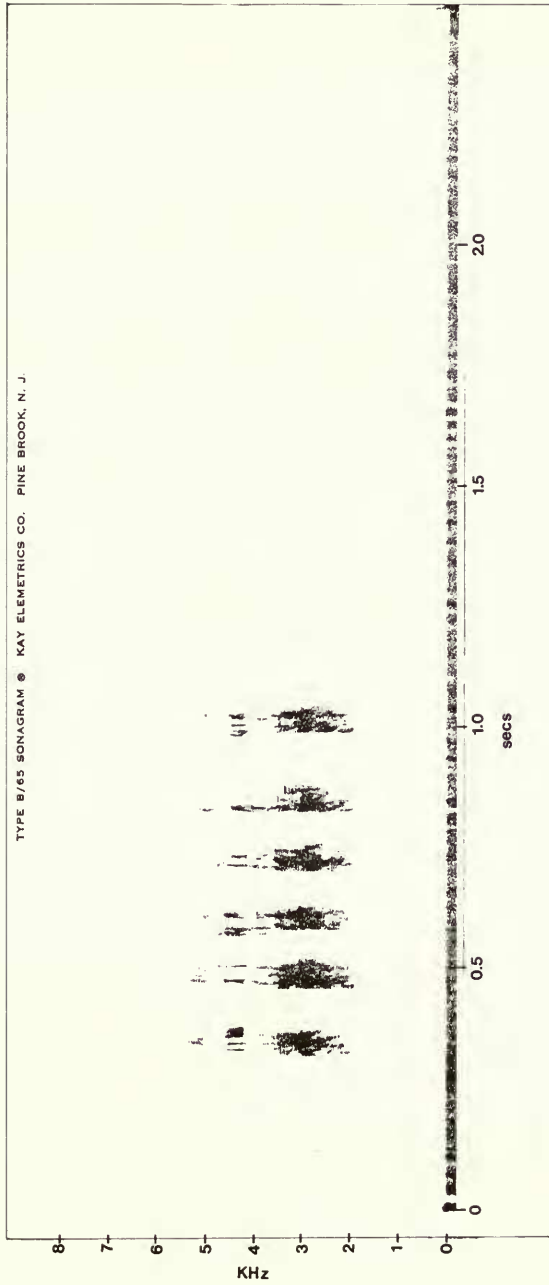


Fig. 14 Sonagram of the mating call of *Rhacophorus cf. reinwardti*.

brown patches. Gular region and under surfaces of fore limbs heavily mottled with dark grey brown. Upper surfaces of finger and toe discs with paired golden brown spots. The syntypes have four narrow distinct dark crossbars on the thighs, this specimen has three blotches. Iris bright golden brown above, duller below.

REMARKS. Boulenger's description and plate (1903) give most of the characteristics of this species. Snout-vent lengths of three adults 39.7-40.6 mm. The major part of the nuptial pad extends across the first metacarpal as far as the subarticular tubercle. There is also a separate small patch of spicules on the median edge of the finger, distal to the subarticular tubercle. There are no supernumerary tubercles at the bases of the fingers. Tibia length relative to snout-vent length is 0.521-0.554 (mean 0.537, N=3). The dorsal tubercles are rounded and less elevated than in *leprosa* and they do not form dorsolateral ridges. The asperities on the tibiae tend to form oblique ridges.

Theloderma leprosa

Hyla leprosa Schlegel, 1837-1844, p. 105.

MATERIAL. BM. 1974. 4909 (♂).

HABITAT. The specimen is from a hillside forest at 790 m on the east ridge of G. Lawit. It was caught at night, 1½ m from the forest floor on the leaf of a *Johannesteysmannia* (a fan-leaved palm).

COLOUR. Dorsum dark chocolate brown, upper flanks reddish brown. Dorsolateral tubercles and tubercles posterior to tympanum khaki. Venter pale grey, heavily blotched with very dark brown. Finger discs, discs of first to third toes, margin of toe web, subarticular, and inner metatarsal tubercles, and nuptial pad all pinkish red. Basal portion of toe web spotted with dark brown. Iris fawn, heavily streaked with black.

REMARKS. The snout-vent lengths of 4 mature males are 59.5-68.8 mm (mean 64.4 mm). The nuptial pad is covered with minute spicules. It extends from the wrist across the dorsomedian surfaces of the thumb pad and narrowly up the fleshy fringe of the first finger to the disc. There are supernumerary tubercles at the bases of all four fingers, but that under the first is indistinct. Broad webbing reaches the base of the disc on the first and fifth toes and the base of the disc or rather below on the outer edge of the second to third toes. It reaches above the subarticular tubercle on the inside of the second toe, as far as the distal tubercle on the inside of the third toe, and reaches the distal subarticular tubercle, on both sides of the fourth toe. Free parts of the digits have a fleshy ridge on the edge; on the fifth toe this is covered by tubercles. The inner metatarsal tubercle is not small as stated in previous descriptions, but moderately large, oval, and from 2.8 to 3.3 mm long in those specimens seen. Tibia length relative to snout-vent length is 0.535-0.546 (mean 0.541, N=3). Combined length of foot and tarsus relative to snout-vent length is 0.716-0.755.

Schlegel's description, based on Müller's specimen from Padang, Sumatra, which was deposited in the Leiden Museum, is the first to be valid by the rules of zoological nomenclature. Müller never published the name which has been ascribed to him, and Tschudi's (1838) diagnosis of *Theloderma* does not provide a recognizable description of the species.

SAURIA

Family GEKKONIDAE

Cnemaspis argus sp. nov.

Plate 1(a)

HOLOTYPE. BM. 1974. 4910, an adult male from 790 m on the east ridge of G. Lawit. Found in a cavity under a stone in or by the bed of a small stream, collected by Atan and Tiee at 1930-2030 hours, 9 March 1974.

PARATYPE. BM. 1974. 4911, female, with the same data as the holotype, from under a rock at the side of the stream.

DIAGNOSIS. A large species of *Cnemaspis* (snout-vent length of ♂ 65.3 mm, of ♀ 62.8 mm) with 25 presacral vertebrae, keeled ventral scales, the fourth and fifth fingers subequal, and lacking a series of conspicuously enlarged median subcaudal scales.

DESCRIPTION OF HOLOTYPE. Nostrils directed upwards. Rostral $\frac{3}{8}$ as high as wide, notched dorsally by a deep groove which does not reach the border of the mouth. A pair of drop-shaped supranasals bordering the nostrils above, and separated mesially by an elongated granule. Anterior border of the first supralabial reaches the nostril. Four or five indistinct granules behind the nostril, upper and lower largest. Eight supralabials to below the pupil, followed by about seven granules which border the mouth. Ten to twelve infralabials followed by two to four granules bordering the mouth. Mental subtriangular, almost as wide as long, border on the mouth $1\frac{1}{3}$ width of rostral border. Two elongate postmentals separated by an almost circular scale and in contact with the first infralabials anteriorly. Canthus rounded, frontal, postnasal and preocular areas concave. Granules above supralabials and behind supranasals enlarged and weakly keeled. Small granules between the eyes. Elongated, erect ciliaries in front of the eyes. Pupil rounded, margin with a weak posterior notch and stronger dorsal and ventral notches. Ear opening as high as first supralabial, higher than wide.

Dorsal granules smaller than ventral scales, smallest along midline, and with up to 3 weak keels. Two paravertebral rows of dorsal tubercles separated posteriorly by 8–10 granules, on neck by 3–4 granules. Other tubercles irregularly scattered over dorsum and flanks and separated from each other by 2–5 granules. Tubercles variable in size, with 3–7 keels. Tubercle size decreases anteriorly over thorax and they become indistinguishable from the surrounding granules over the back of the skull. A pale tubercle above and in front of each ear opening with a smaller, flatter tubercle behind it. No distinct linear series of large pale tubercles on the nuchal region or on the sides of the neck.

Throat granules small, increasing in size towards infralabials and neck. Belly scales cycloid, subimbricate and keeled. About 60 scales in a midbody chevron across the belly between the lowest tubercles on the flanks, middle 20–40 are subimbricate. A chevron of 10 well-developed preanal pores occupying a low mound anterior to the ischia. Lateral edges of chevron separated from vent by 10–11 subimbricate scales and about 6 granules. Openings of the postanal sacs separated from vent by pigmented skin and held open by a colourless spongy substance.

Tail regenerated after fifth autotomy segment. An oblique row of three conical tubercles posterolateral to vent on sides of hemipenial swellings. Another conical tubercle on posterior margin of each swelling with two more tubercles on the sides of the tail above it. Six enlarged, weakly keeled scales near the posterior margin of each autotomy segment, two dorsolateral pairs and a lateral pair. On the first segment a further four enlarged scales, a dorsal pair anterior to the inner dorsolateral pair, and a lateral pair below the usual lateral tubercles. No row of distinctly enlarged median subcaudal scales. Subcaudals about as large as scales under femora, hexagonal and keeled.

Limbs moderately long and slender. Fourth finger moderately long, not longer than fifth (see Table 4). No rows or patches of very enlarged scales on ventral surfaces of femur, tibia, tibiotarsal articulation or first metatarsal. Ventral femoral scales not sharply distinguished from granules on posterior femur, largest proximally where they are flattened and barely larger than midbelly scales. No femoral pores. Sixteen to nineteen scales under first metatarsal, between the enlarged scale at the base of the first finger and the mound covering the tibial-metatarsal articulation. Subdigital scales tend to be broken up on the proximal phalanx and proximal part of the raised portion of each digit. The distal subdigital scales are those between the enlarged plate under the point of inflexion of the finger, and the claw.

Distal subdigital scales I : 15. II : 21. III : 24–25. IV : 23–24. V : 23–24.

Pattern as in Plate 1. In life, dorsal surfaces dark brown and fawn. Pale grey paravertebral blotches and bands on the tail. Chrome yellow oblique stripes radiating from the eye. Vertical

disrupted bands of chrome yellow on the flanks. Indistinct yellowish markings on the fawn areas of the limbs. The undersurfaces pale pinkish grey. The iris bright copper.

DESCRIPTION OF PARATYPE. The female paratype agrees closely with the holotype. It has 9–10 supralabials followed by 6 or 7 granules, and 12 infralabials followed by 1–3 granules. It has no preanal pores or preanal mound, and the openings of the postanal sacs are empty. The scales under the femora are not differentiated and are smaller than the midbelly scales. There is a series of three to four tubercles posterolateral to the vent which are less well developed than in the male. The tail is entire. Enlarged scales are present near the posterior margins of the first fifteen autotomy segments. There are no conspicuously enlarged subcaudals anywhere along the length of the tail. The tail pattern is of longer black and shorter pale bands which are grey anteriorly and white, speckled with black posteriorly.

Distal subdigital scales I: 14–15. II: 22–23. III: 25. IV: 22–23. V: 24.

Table 3 Measurements (mm) of the holotype and paratype of *Cnemaspis argus*

	Holotype	Paratype
Snout-vent length	65.3	62.8
Tail length	—	91.6
Head length (to ear opening)	15.3	14.4
Head width	10.8	10.3
Distance between knees (with femora perpendicular to body)	36.0	35.4

REMARKS. The species is not named for the hundred-eyed figure of mythology but for Argus Gathorne-Hardy, younger son of the expedition leader, Lord Medway.

Southeast Asian species of *Cnemaspis* have 25 presacral vertebrae as the usual number (29 specimens out of 32 examined) while the Indian species seen have 26 presacral vertebrae (17 specimens out of 21 examined). The single southeast Asian specimen of *kandianus* which I X-rayed had 26 presacral vertebrae. The species examined by X-ray were *affinis* (6), *argus* (2), *boulengeri* (1), *kendalli* (2), *kumpoli* (2), *nigridius* (18), *siamensis* (1), *beddomei* (6), *indicus* (11), *jerdoni* (1) and *kandianus* (3).

Only two of the southeast Asian group of species reach or exceed the size of *C. argus*. These are *nigridius* (Smith), which differs from *argus* in having a short fifth finger and enlarged smooth subcaudal scales, and *boulengeri* Strauch, which also has these characters and in addition has smooth ventral scales and enlarged subtibials. A group of taxa are like *argus* in having keeled

Table 4 *Cnemaspis*, fourth finger lengths

Material	Number	Relative to SV length		Relative to forearm length	
		Mean	Range	Mean	Range
species B	1		0.163		0.950
<i>kendalli</i>	4	0.149	0.142–0.158	0.829	0.777–0.845
<i>nigridius</i>	4	0.147	0.138–0.162	0.805	0.776–0.851
<i>argus</i>	2		0.134–0.144		0.785–0.839
<i>siamensis</i> (N)	4	0.112	0.105–0.120	0.722	0.685–0.754
<i>siamensis</i> (S)	4	0.119	0.114–0.125	0.761	0.714–0.807
<i>affinis</i>	4	0.121	0.112–0.133	0.773	0.729–0.847
<i>flavolineatus</i>	1		0.123		0.791
species A	2		0.116		0.686–0.741
<i>kumpoli</i>	1		0.112		0.712
<i>boulengeri</i>	4	0.127	0.122–0.132	0.698	0.678–0.719

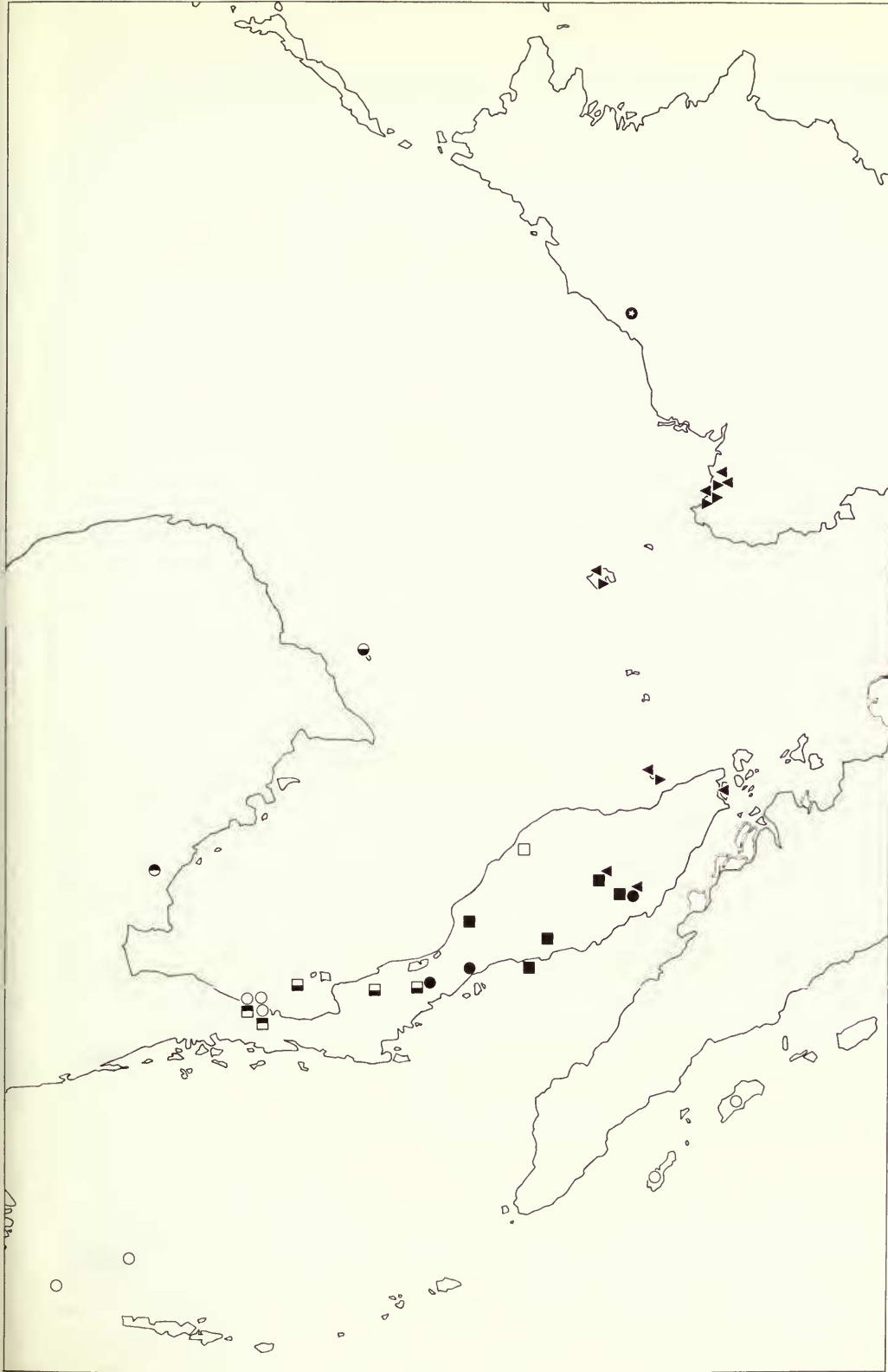


Fig. 15 The distribution of *Cnemaspis* in southeast Asia. *C. kandianus*: hollow circle. *C. boulengeri*: circle with left half filled. *Cnemaspis* sp. A: circle with right half filled. *C. kumpoli*: solid circle. *C. kendalli*: triangle. *C. nigridius*: inverted triangle. *Cnemaspis* sp. B: star in circle. *C. argus*: hollow square. *C. affinis* and *C. flavolineatus*: solid square. *C. siamensis*: half-filled squares to show the northern and southern populations separately. The southernmost records of *C. kandianus* (Sipora and Engano) and the northernmost record of *C. siamensis* (Ban Sadet) have been omitted.

ventral scales and the fifth finger equal in length to the fourth, these are *siamensis* (Smith), *affinis* Stoliczka and *flavolineatus* Nicholls. All are considerably smaller than *argus* and all have a rather lower number of distal subdigital scales under the toes and have relatively shorter fingers. In addition, *siamensis* differs in having a series of enlarged median subcaudal scales, and *affinis* has fewer preanal pores and tubercles at the side of the vent and differs in details of the colour pattern.

Because identification of *Cnemaspis* can be difficult I give below a key to the sundan-indochinese species, a table of data on finger length (see Table 4) and a map. This is based on most of the relevant material in the British Museum (Natural History), Field Museum of Natural History, United States National Museum and Bernice P. Bishop Museum, Hawaii.

Key to the southeast Asian species of *Cnemaspis*¹

- 1A Males with femoral and preanal pores. Proximal subdigital scales much larger than distal scales which are 7-9 : 8-11 : 11-13 : 11-12 : 11-13 under the first to fifth toes. Adults 27-35 mm in snout-vent length. Ventral scales and proximal subcaudal scales smooth, distal subcaudals keeled. 26 presacral vertebrae are usual *kandianus*²
- B Males lack femoral pores. Proximal subdigitals not, or little, larger than distal subdigitals which are 10 : 11 : 14 : 15 : 14 or more. 25 presacral vertebrae are usual 2
- 2A Ventral abdominal scales smooth, subcaudals smooth 3
- B Ventral abdominal scales keeled 5
- 3A Adults 59-66 mm in length. Fifth finger shorter than fourth. A series of shield-like subtibial scales almost as wide as the tibia, subcaudals almost as wide as the tail. No preanal pores. Digital subdigitals 11-15 : 13-15 : 16-19 : 16-18 : 16-20. Con Son (island), Vietnam *boulengeri*
- B Adults 51 mm or less. Fifth finger subequal to fourth. No series of shield-like subtibials, subcaudals less than half width of tail. Males with preanal pores 4
- 4A Snout relatively short and deep. Distal subdigitals 10-12 : 16-17 : 17-19 : 17-19 : 18-20. About 9 scales below the first metatarsal. Adult males 34-42 mm in length, with 8 preanal pores. About 28-30 scales around mid tibia. Southeast Thailand species A³
- B Snout relatively long and flattened. Distal subdigitals 13-17 : 20-22 : 21-25 : 21-24 : 20-26. 12-17 scales below first metatarsal. Adult males 36-51 mm in length, with 8 preanal pores. About 24-32 scales around mid tibia. Malay Peninsula *kumpoli*⁴
- 5A Terminal phalange of fifth finger reaches base or middle of penultimate phalange of fourth finger, which is relatively long (see table 4) 6
- B Fifth finger subequal to fourth 8
- 6A Median subcaudal scales smooth, rounded and flat. Adult size to 85 mm, males with up to 16 preanal pores (Borneo) or preanal pores usually absent (P. Tioman). Enlarged postmentals present. Distal subdigitals 10-13 : 13-15 : 18-21 : 17-21 : 16-20 (Borneo and Bunguran populations) or 13-16 : 16-20 : 20-25 : 20-24 : 20-25 (P. Tioman) *nigridius*⁵
- B Median subcaudals keeled, pointed and raised. Adult size to 58 mm 7
- 7A Preanal pores absent. Enlarged postmental scales present. Venter lightly pigmented, no black area covering the flanks. Adults to 58 mm. Distal subdigital scales 10-13 : 13-15 : 18-22 : 18-23 : 17-20 *kendalli*⁶
- B Preanal pores present (6). Enlarged postmental scales absent, mental deep and rounded. Venter heavily pigmented with the exception of scattered scales, flanks black with a few white patches (in alcohol). Adult male 46.7 mm. Distal subdigitals 13 : 14 : 20 : 20 : 19-20 species B⁷
- 8A Adults about 64 mm. Fingers relatively long. Distal subdigitals 14-15 : 21-23 : 24-25 : 22-24 : 24. Preanal pores 10. Subcaudals keeled, no enlarged median series *argus*
- B Adults less than 50 mm. Fingers relatively short. Distal subdigitals fewer, to 14 : 19 : 22 : 20 : 21 9
- 9A Median subcaudal scales keeled, not distinctly larger than adjacent scales, about five per autotomy segment proximally. Distal subdigitals 11-14 : 16-19 : 17-22 : 17-20 : 17-21, many of the more proximal of them broken up into smaller scales. Usually 2 tubercles at the side of the vent. Usually a dark blotch or ocellus above arm insertion. No median dark line on the throat. Males with 2-6 preanal pores are 27.7-46.7 mm in length *affinis*⁸
- B Median subcaudal scales in a series of keeled, weakly pointed, enlarged scales, about four per autotomy segment proximally 10
- 10A Distal subdigitals 10-13 : 16-19 : 17-22 : 17-22 : 16-20, some of the more proximal members broken up into smaller scales. Usually one tubercle at the side of the vent. No dark blotch

- above arm insertion. No median dark line on throat. Males with 4–8 preanal pores are 30.7–39.7 mm in length. Northern Malay Peninsula *siamensis*
- B Distal subdigitals 9–11 : 11–15 : 14–20 : 15–21 : 14–19 and none are broken up. Usually 2 tubercles at the side of the vent. No dark blotch above arm insertion. A median dark line on the throat. Males lack preanal pores. Adults 32.9–38.0 mm in length. North of the Isthmus of Kra *siamensis*⁹

Notes on the key

- 1 Not including the nominal species *timorensis* Duméril and Bibron.
- 2 Including the material called by Taylor (1963) *C. mysoriensis* (Jerdon).
- 3 BM 1917.5.14.5, BM 1926.12.7.2, FMNH 191479. Previously reported (Smith, 1925*b*; Taylor, 1963) as *C. siamensis*.
- 4 Three male specimens from Khao Chao, Trang (the holotype), from Kaki Bukit, Perlis and from the Batu caves, Selangor differ in size, in density of the dorsal tuberculation, in size of the scales under the tibia, in elements of the pattern and, possibly, in head shape. They are conveniently referred to *kumpoli*.
- 5 This species has been confused with *C. kendalli* and has also been referred to as *Cnemaspis* sp. (Hendrickson, 1966). The populations from the 1st Division, Sarawak, from Bunguran and from Pulau Tioman, Pahang, differ in presence or absence of preanal pores, numbers of distal subdigitals, density of dorsal tuberculation, number of scales along the first metatarsal and in the shape of the tubercles on the tail and at the sides of the vent.
- 6 One of the syntypes of *C. kendalli* (BM.XXII. 92b) is an immature specimen of *C. nigradius*. I therefore formally designate the other syntype, BM.XXII 92a (J. E. Gray's number), an adult male from Borneo, presented to the museum by Sir E. Belcher, as the lectotype.
- 7 FMNH 148588 from Labang camp, Bintulu district, Sarawak.
- 8 I have not been able to find clear differences between *flavolineatus* and *affinis*. The holotype of *flavolineatus*, with the preanal pores functioning, is 27.7 mm in length. Penang males are 39.1–46.7 mm in length (mean 43.9 mm, N=7). Four males from Bukit Besar, south Thailand, are 31–41 mm in length and show variation in the shape of the mental shield, a character used by Nicholls (1949) to diagnose *flavolineatus*.
- 9 The two populations of *C. siamensis*, and *C. affinis*, seem to replace each other geographically. Most of the differences between them are comparable to the differences between the three populations I place in *nigradius*. A specimen from central north Thailand (Cochran, 1930) is too badly preserved to be definitely identified as *siamensis*.

Cyrtodactylus consobrinus

Gymnodactylus consobrinus Peters, 1871.

MATERIAL. BM. 1974. 4913 (juvenile).

HABITAT. Found 2½ m above the ground on the trunk of a large tree in secondary forest at the Sungei Kelebang (43 m).

COLOUR. Dorsal surfaces jet black, banded and reticulated by yellow cream, which is yellowest on head. Broad dark dorsal bands fade centrally into dark brown. Supralabials black and grey spotted with white. All ventral surfaces except tail pale grey. Tail dark ventrally with narrow pale bands broken on subcaudals. Iris chestnut reticulated with black.

Cyrtodactylus elok sp. nov.

Plate 1(b); Fig. 15

Cyrtodactylus ? *brevipalmatus*, Grandison, 1972.

HOLOTYPE. BM. 1967. 2783, adult male, at the base camp of the G. Benom expedition (215 m). Caught at night on leaf litter of the forest floor near the camp clearing and a stream.

PARATYPE. BM. 1974. 4912, adult male, near the Sungei Kelebang camp (43 m). Caught at night in thick secondary growth of palms and other shrubs among trees by a logging track. This gecko was seen moving slowly down a slender stem, apparently using its tail as a climbing aid. At rest the tip of the tail is coiled laterally.



Plate 1 (a) *Cnemaspis argus* Holotype



Plate 1 (b) *Cyrtodactylus elok* Holotype

DIAGNOSIS. A *Cyrtodactylus* with greatly enlarged proximal subdigital lamellae and with basally webbed toes, lacking femoral pores or enlarged femoral scales, but with a weakly arched series of preanal pores.

DESCRIPTION OF HOLOTYPE. Head oviform, forehead concave, snout obtusely pointed, its length $1\frac{1}{2}$ – $1\frac{2}{3}$ times eye diameter. Ear opening almost round, separated from eye by more than eye diameter. Eye with vertical *Gekko* type pupil. Nostril bordered in front by rostral, entered by the first supralabial, by an internasal and, posteriorly, by a concave scale bordered behind by five granules. Rostral large, quadrangular, with a vertical median groove in the upper part, and bordered behind by three internasals. Eight to nine supralabials extending to just behind centre of eye, followed by 3–4 scales little larger than the adjacent granules. Nine lower labials in total. A large, subtriangular mental followed by one pair of postmentals meeting on the midline and a second widely separated pair.

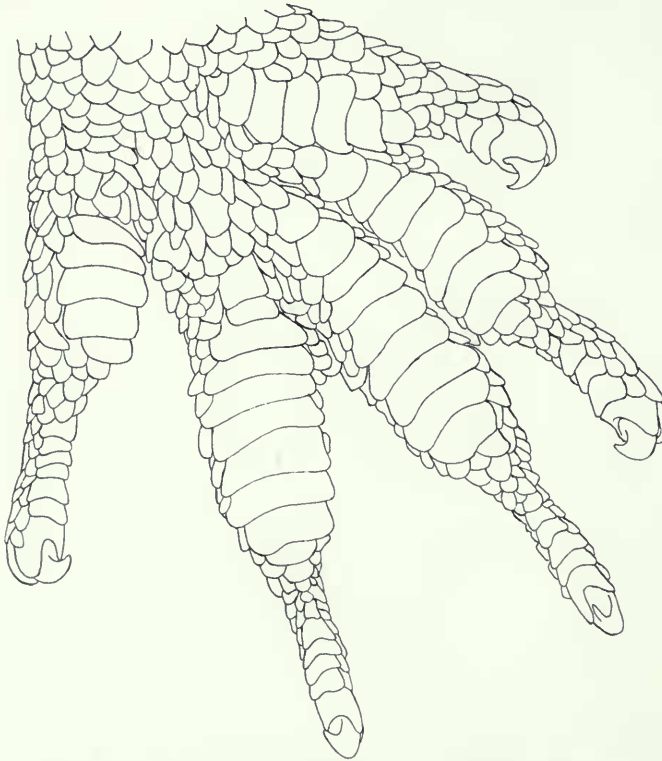


Fig. 16 Foot of the holotype of *Cyrtodactylus elok*.

Body slightly flattened, covered above by small flattened granules. Dorsal tubercles rather rounded and flattened with a weak median keel, irregularly arranged, 6–8 across middorsum, separated by 4–9 granules. Tubercles also on occiput and upper surfaces of limbs and tail base. A well-developed ventrolateral ridge with flattened imbricate scales generally larger than the adjacent granules. Ventral scales smooth, cycloid and about as large mesially as the dorsal tubercles, 44 across midbody. No preanal groove. Males with a weakly arched series of enlarged preanal scales, with 8 preanal pores. Surrounding scales larger than remaining ventral scales, separated from vent by a band of granules. Ventral surface of thigh lacking a series of enlarged femoral scales and without femoral pores. Anteroventral scales of thigh smaller than midbelly scales and merging into granules on posterior face of thigh without any distinct boundary. A pair of enlarged flattened scales to each side of vent on hemipenial swellings.

Proximal parts of each toe expanded and flattened, distal parts laterally compressed and raised. Subdigital lamellae of proximal parts many times width of adjacent scales, about five times width of scales on dorsal surface of toe. Fourth toe with 19 scales below (Fig. 16). Rudiment of web between toes I and II, well-developed web between toes II and III, III and IV. Well-developed proximal subdigital lamellae and rudimentary webbing also present on digits of hand.

Tail flattened, quadrangular in cross-section. Dorsolateral and ventrolateral edges of tail formed by denticulated series of elongate tubercles. Basally another paired series of tubercles on the dorsal surface of the tail, otherwise dorsal and lateral tail surfaces covered by granules. Ventral surface of tail covered with enlarged, flattened scales, the largest forming a mesial series two to four scales wide.

DESCRIPTION OF PARATYPE. Smaller but otherwise very similar to the holotype. Posterior border of nostril formed by 2 granules. Supranasals separated on midline by two small scales. Eleven supralabials, 8-9 to below centre of eye and 10 infralabials. About 10 dorsal tubercles counted across midbody. Two or three enlarged scales at the sides of the vent. Eighteen to nineteen scales beneath the fourth toe. A broad yellow to silver brown middorsal band crossed by seven darker brown bars on the body. Flanks and dorsal surfaces of limbs and head dark brown. Tail the same colour as the middorsal band with brown cross bars on the proximal part. A white streak from below the eye on to the posterior supralabials. Anterior labials barred cream and brown. Cream streaks behind the eye. Throat cream with white patches and dark speckling. Belly colourless except for dark speckling. Ventrolateral fold pale edged, with a series of four or five cream spots along it. Iris white with dark veins.

Table 5 Measurements (mm) of the holotype and paratype of *Cyrtodactylus elok*

	Holotype	Paratype
Snout-vent length	67.5	56.6
Head length (to ear opening)	18.2	14.6
Head width	14.3	11.2
Distance between knees (with femora perpendicular to body)	31.1	25.3
Tail length	75.7	70.0
	(tip regenerated)	

REMARKS. The name is Malay for beautiful. This species is closely related to *C. brevipalmatus* (Smith) which also has greatly enlarged proximal subdigital lamellae and basally webbed toes. Two adult *C. brevipalmatus* have weakly arched series of 7-9 enlarged preanal scales separated by 4-5 small scales from series of 7-9 enlarged femoral scales. The adult male holotype has 9 preanal and 6 and 7 femoral pores. The new species has a similar series of preanal scales and preanal pores but lacks enlarged femoral scales and lacks femoral pores. In no other species of *Cyrtodactylus* may enlarged femoral scales be either present or absent, although the number of femoral pores varies in some species (in three Javan *C. marmoratus* males which I have seen there are 7-18 femoral pores in total). Other differences of the new species from *brevipalmatus* are as follows.

There are fewer dorsal tubercles than in *brevipalmatus*. There are 6-10 tubercles counted across the midbody in a rough line, which are separated from each other by 4-9 granules. In *brevipalmatus* there are 14-18 tubercles across the midbody, separated by 1-5 granules.

The distal portions of the digits (that is, distal to the expanded subdigital lamellae) are shorter and have fewer subdigital scales as shown in Table 6.

Table 6 Numbers of distal subdigitals of *Cyrtodactylus elok* and *C. brevipalmatus*

Toe	I	II	III	IV	V
<i>elok</i>	5-6	6-7	9-10	9-10	9
<i>brevipalmatus</i>	8-9	9-11	11-13	11-13	11-13
Finger	I	II	III	IV	V
<i>elok</i>	4-5	6	8	8-9	7
<i>brevipalmatus</i>	7-8	9-10	10-11	10-12	9-10

Cyrtodactylus quadrivirgatus

Cyrtodactylus quadrivirgatus Taylor, 1962.

MATERIAL. BM. 1974. 4914-4924 (8 ♂♂, 2 ♀♀, 1 juvenile).

HABITAT. All were collected at night, mostly above the ground and from as high as two metres above it, from the trunks of dead trees, the fissures of a log and from spiny palms, vines, saplings and other shrubby vegetation. Seven were from the Kelebang camp (43 m), near the river, at the edges of logging tracks, and in the intensely disturbed forest. Four were from the east ridge of G. Lawit (790 m) near streams and in ridge top forest.

COLOUR. The dorsal surfaces vary from fawn to dark grey brown with blackish brown markings, the venter is grey. The tubercles on the flanks and sides of the head, and the supraciliaries, may be yellowish. The iris was described variously as grey, ochre and dark brown in the field.

REMARKS. All the geckos from the Malay Peninsula which were previously identified in the BM(NH) as *C. marmoratus* Kuhl, are referable to *C. quadrivirgatus*. This species differs from all other Sundan *Cyrtodactylus* (except *C. annulatus* Taylor and *C. sworderi* Smith) in lacking a pubic groove and femoral pores, as well as enlarged subcaudal scales and denticulated series of elongated tubercles on the ventrolateral folds or sides of the tail. *C. annulatus* of Mindanao and Bohol lacks enlarged femoral scales which are present in *quadrivirgatus*. *C. sworderi* of the Malay Peninsula, which is known only from the male holotype, differs in size (77 mm), in number of preanal pores (6), and in pattern (pale blotches on a dark ground). Adult males of *quadrivirgatus* are 51-65 mm in head and body length, females are up to 71 mm long. About half the males lack preanal pores, the remainder have up to four. The additional BM material comes from Bukit Besar, on the Pattani-Yala border in Thailand; from Penang Hill; from G. Keledang, the Larut Hills and Kuala Legap in Perak; from G. Benom, Pahang; from G. Bunga Buah, Selangor and from Singapore. *C. marmoratus* should be removed from the fauna of the Malay Peninsula, all records being presumably based on *quadrivirgatus* (and certainly those of Flower, 1899, Boulenger, 1903, Smith, 1935*b* and Grandison, 1972).

The range of *C. marmoratus* has been constantly reduced since de Rooij (1915) recorded it from New Guinea westwards to the Indian Ocean. Brongersma (1953) showed that records beyond Malaya, the Riouw Archipelago, Sumatra and the islands to its west, Java, Bali and Lombok were erroneous. He also indicated that the Christmas Island population was distinct. Taylor (1962) made comments on the diversity of the remaining assemblage. The type locality is Java. In three Javan males which I have seen there are up to 16 preanal pores separated from series of 3-10 femoral pores on each thigh by 4-7 poreless scales, but according to Brongersma (1953) the preanal and femoral pore series may be contiguous. The pore bearing preanal scales rim the pubic groove. The largest male is 74.4 mm in snout-vent length.

In three Sumatran males and an Engano male it is the scales anterior to the pore-bearing series that rim the pubic groove. The anterior median scale of the preanal series is greatly enlarged, occupies the bottom of the pubic groove, and bears the anterior preanal pore. It is followed by two continuous series of 8-15 pores extending on to the femora. The largest specimen is 66 mm long. Six males from Christmas Island, south west of Java and Sumatra, also differ from the Javan population. They have 9-11 preanal pores in an open series, not rimming a pubic groove,

11–13 femoral pores on each side and 3–8 poreless scales between the preanal and femoral series. These males are 73.0–78.9 mm long, while five females are 73.2–81.6 mm long. Possibly a proper study of the *marmoratus* group would show that a number of species are present in western Indonesia.

Gehyra mutilata

Hemidactylus (*Peropus*) *mutilatus* Weigmann, 1835.

MATERIAL. BM. 1974. 4925 (♀).

HABITAT. Under the bark of a dead tree in secondary trackside vegetation at the Sungei Kelebang camp.

Ptychozoon lionotum

Ptychozoon homalocephalum var. nov. *lionotum* Annandale, 1905.

MATERIAL. BM. 1974. 4926 (♂).

HABITAT. The gecko was 2–3 m up on a tree trunk in undisturbed forest near the Sungei Petuang (250 m), and was found at night.

REMARKS. Boulenger (1893) noted the presence of a *Ptychozoon* at Pegu which lacked dorsal tubercles, and Annandale gave it a name. Boulenger (1912) included *lionotum* in his discussion of *homalocephalum* (= *kuhli*), but Smith (1935a) raised it to the status of a species. Taylor (1963) was the first to record *lionotum* from the Malay Peninsula. He found it in near sympatry with *kuhli* in Changwat Nakhon Si Thannarat, and as far south as Changwat Trang, and also listed the differences between the two species. Material in the BM. shows that *lionotum* is also found in West Malaysia and Borneo, where it has been previously recorded as *kuhli* or *homalocephalum*. I have seen an embryo and hatchling from Bukit Besar, on the borders of Changwats Pattani and Yala (recorded by Boulenger, 1903 and Taylor, 1963), a male from Gunong Tahan, Pahang (recorded by Boulenger, 1908) and a male and female from the Baram district of Sarawak (recorded by Smith, 1935a).

P. lionotum differs from *kuhli* in lacking tubercles on the occiput, dorsum or dorsal surfaces of the tail segments, in having a notch largely separating the skin flap on the anterior edge of the forelimb from the first finger, and in having a smaller flap on the tail tip and the lateral tail flaps differently oriented. It also has fewer preanal pores, 16–24 in 6 males I have seen, 31 and 43 in two Malayan *kuhli*, one of which has the preanal pores in more than one row. Adult males of *lionotum* are 68–90 mm in snout–vent length and females are 84–103 mm long.

There is some geographical variation. Three specimens from north and east Thailand have a weak mound above the ear opening, covered with enlarged scales. The weak posterior lobe of the skin flap on the side of the neck is rounded and there is a single large tubercle on the side of the hemipenial swelling. The Malay Peninsula specimens have a free knob above the ear opening. This is followed by a strong fold to the posterior end of the neck flap where there is a further knob. The posterior lobe of the neck flap is triangular and the specialized tail-base tubercles are single. The two Bornean specimens are similar but the swelling above the ear opening is flap-shaped and the tubercles on the sides of the hemipenial swellings are divided.

Family AGAMIDAE

Aphaniotis fuscus

Otocryptis (*Aphaniotis*) *fusca* Peters, 1864.

MATERIAL. BM. 1974. 4927 (♂).

HABITAT. The single example was found about a metre from the ground on the trunk of a tree in the disturbed forest around the Sungei Kelebang camp (43 m).

COLOUR. The head and body are greenish ochre, the tail somewhat browner with a light tip. The lining of the mouth is bluish purple. The iris is bright blue.

Calotes cristatellus

Agama cristatella Kuhl, 1820.

MATERIAL. BM. 1974. 4928 (immature).

HABITAT. The specimen was seen on the ground in the Sungei Kelebang camp site but when chased it ran up on to the palm-thatched roof of a hut.

Calotes sp.

MATERIAL. BM. 1974. 4929 (juvenile male).

HABITAT. This lizard was caught near the summit ridge camp at 1280 m. It was found during the afternoon on a dead branch of a bush growing on the steep side of a dry gully, and was about half a metre above the ground.

COLOUR. Dorsum greyish fawn with five dark brown crossbars over the thorax and abdomen. Five dark bars radiating from the eye, three below it and two behind it. A small black v-shaped mark on the nape. The tail crossbarred fawn and dark brown. The midline of the throat and venter pale bluish, the remainder of the venter and upper lip whitish in life, now heavily scattered with melanophores. The area of the gular sac with an oval blue black ocellus enclosing a pinkish purple patch, which has become orange in the preserved specimen. Dark lines radiating from the area of the gular sac to the infralabials. The palate dark blue. The iris dark brown.

REMARKS. This juvenile evidently belongs to the same species as the Gunong Tahan syntype of *C. floweri* Boulenger in the British Museum, a gravid female, BM. 1906.2.28.10. However, neither is conspecific with the Chantaburi syntype of *floweri*. Taylor and Elbel (1958) restricted the type locality of *floweri* to Chantaburi. I therefore formally designate the gravid female syntype from 'Chantaboon' (=Chantaburi), BM. 1946.8.11.25, collected by Captain S. S. Flower, as the lectotype.

The Gunong Tahan and Gunong Lawit specimens differ from *Calotes floweri*, in having a shorter head, fewer upper and lower labials, and scales along the canthus between the nasal and the supraciliaries, in having more scales under the fourth finger, and in being a smaller size.

These two specimens belong to the group of small, highland *Calotes* defined by Smith (1935a) as having the following characteristics: no fold or pit in front of the shoulder, dorsal and lateral scales pointing backwards and downwards and larger than the midventral scales, limbs relatively short (adpressed hind limb reaching shoulder). This group includes the Indochinese species *brevipes* Werner (see Mertens, 1954, for taxonomy), *floweri* Boulenger and *microlepis* Boulenger, and the Sundan species *flavigula* Smith and *tympanistra* Gray as well as this form. The three Indochinese species can be separated from the three Sundan species by the modified scales under the proximal part of the third toe (Fig. 17). In all six species the subdigital lamellae are bicarinate and the distal ends of the keel are raised to form spines, presumably as a modification for an arboreal life. In the Indochinese species the keels on the leading edge of the third toe are greatly enlarged and blade-like while the keels on the trailing edge of the toe at the base are reduced or absent. The Sundan species have normal bicarinate lamellae to the base of the third toe. Diagnoses of the species, based on the 14 specimens in the BM(NH), are given below.

Subdigital scales of the third toe are modified (see above).

C. floweri, range southeast Thailand and southwest Cambodia. Abdominal scales large, 50–54 round midbody, c. 35–41 dorsolateral scales. 20–24 scales under fourth toe, 16–19 scales under fourth finger. 10–11 upper and 9–10 lower labials. Male with a dark brown oval patch on the small gular sac. No enlarged paravertebral scales. Snout 1.5–1.85 times the length of the orbit. Snout-vent length of ♂ and two ♀♀ 90–99 mm.

C. brevipes, range northern Vietnam. Snout 1.5–1.6 times the length of the orbit. 10 upper and 8–10 lower labials. Male with a dark brown patch on the small gular sac. Abdominal scales moderate, 71–72 round midbody, *c.* 56–60 dorsolateral scales. Some spine-like scales on the occiput and a paravertebral series of enlarged dorsal scales. 20–22 scales under fourth toe, 18–19 scales under fourth finger. Snout–vent length of two ♂♂ 76 mm.

C. microlepis, range north Tenasserim and possibly to southern Vietnam. Snout 1.5–1.6 times the length of the orbit. 8–10 upper and 9–10 lower labials. Male with a small dark brown gular sac. Abdominal scales moderate, 70–71 round midbody, *c.* 56–62 dorsolateral scales. No series of enlarged paravertebral scales. 24–26 scales under fourth toe, 20–21 scales under fourth finger. Snout–vent of gravid ♀ from Tenasserim 62.2 mm, of gravid ♀ from southern Vietnam 85.5 mm.

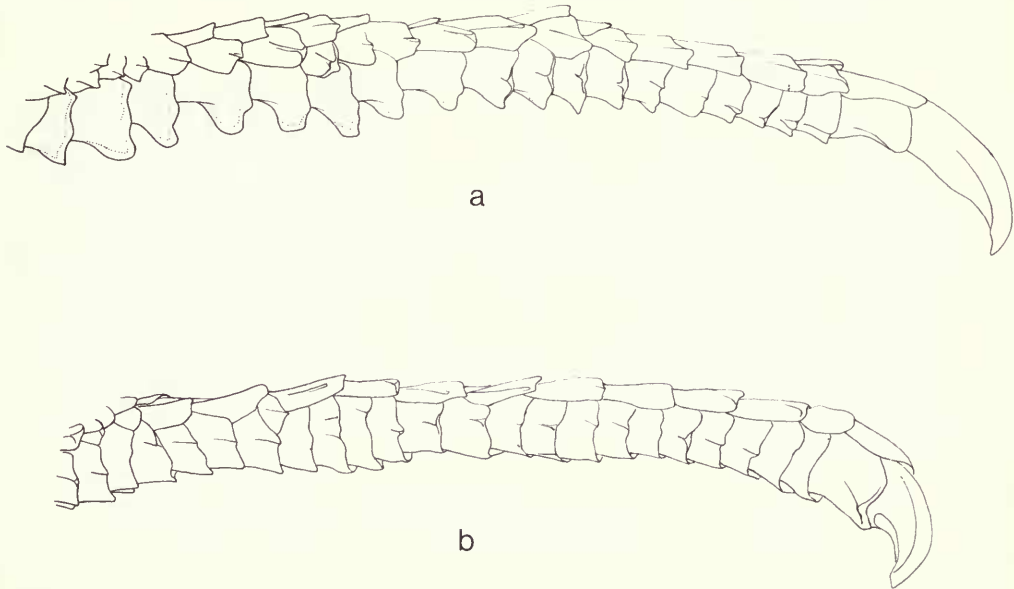


Fig. 17 Middle digit of the right foot of (a) *Calotes floweri* lectotype, and (b) *Calotes* sp. from Gunong Tahan.

Subdigital scales of the third toe are unmodified.

C. flavigula, range Malay Peninsula. Snout 1.3 times length of orbit. Seven upper and 8–10 lower labials. Male with a large bright yellow gular sac. Abdominal scales very large, 40 round midbody, *c.* 29 dorsolateral scales. No series of enlarged paravertebral scales. 31–32 scales under fourth toe, 26–27 scales under fourth finger. One ♂ 66.5 mm in length.

C. tympanistra, range Sumatra and Java. Snout 1.5–1.6 times length of orbit. 10–11 upper and 9–11 lower labials. Male with a small gular sac which is bluish grey in alcohol. Abdominal scales large, 46–54 round midbody, *c.* 38–46 dorsolateral scales. Some enlarged dorsal scales in the paravertebral area. 28–31 scales under the fourth toe, 23–26 scales under the fourth finger. Snout vent lengths of two ♂♂ and a ♀ 64–78 mm.

Calotes sp., range Malay Peninsula. Snout 1.4 times length of orbit. Eight upper and 7–8 lower labials. Gular sac of male is probably brightly coloured. Abdominal scales large, 48–50 or 57 round midbody, *c.* 36–37 dorsolateral scales. No series of enlarged paravertebral scales. 24–26 scales under fourth toe, 20–21 scales under fourth finger. Length of one ♀ is 70.3 mm.

The synonymy of the unnamed species includes *C. microlepis*, Boulenger (1908) and *C. floweri* Boulenger (1912) (part), Smith (1922), Smith (1930) and Smith (1935a) (part). The synonymy of *C. floweri* includes *C. microlepis*, Flower (1899) and *C. floweri* Boulenger (1912) (part), Smith (1935a) (part), Taylor and Elbel (1958) and Taylor (1963).

Draco formosus

Draco formosus Boulenger, 1900.

MATERIAL. BM. 1974. 4930–4933 (1 ♂, 1 ♀, 2 immature).

HABITAT. Of the three caught around the Sungei Kelebang camp at 43 m, two were knocked from saplings during the early morning. An immature specimen was shot while 3 m up on a 35 cm diameter tree in undisturbed forest at 790 m on the east ridge of G. Lawit.

COLOUR. As reported by Grandison (1972). The iris is yellowish green with a golden rim round the pupil.

Draco melanopogon

Draco melanopogon Boulenger, 1887a.

MATERIAL. BM. 1974. 4934–4950 (11 ♂♂, 3 ♀♀, 3 immature).

HABITAT. Only 1 specimen was caught at the Sungei Kelebang, probably because thick secondary growth interfered with observation rather than because of any altitudinal preference of the species. On the east ridge of G. Lawit (790 m) 1 specimen was found 2.5 m and the remainder 4.5–6.0 m above ground but the absence of specimens from higher up on trees reflects the difficulty of shooting them there. They were found on trees from a few to c. 50 cm in diameter. Many were found in forest with little undergrowth and few low branches on the trees on a flat-topped ridge between two streams. Others were on trees of forested slopes overhanging the streams or edging ridge top tracks.

COLOUR. As described by Grandison (1972), except that the orange brown of the throat extends on to the posterior basal third of the black gular pouch of the male. The gular pouch of the female is dark brown with a white to grey green tip. The ventral surface of the wattles is white in males, but in females is a continuation of the reddish brown colour of the base of the gular sac.

Draco quinquefasciatus

Draco quinquefasciatus Hardwicke and Gray, 1827.

MATERIAL. BM. 1974. 4951 (♀).

HABITAT. This was caught at night 'asleep' on the trunk of a tree in riverine forest near the Sungei Kelebang camp (43 m).

COLOUR. Dorsum pale greenish grey with darker grey green crossbars and black spots. A mask-shaped pinkish grey mark on the nape. The upper surfaces of the wings orangey brown fading to yellowish at the body, crossed by five black bars and by stripes of lighter scales over the ribs. Throat yellowish green and venter pinkish white flushed with yellow at the sides. Undersurfaces of the wattles orange yellow anteriorly, white posteriorly, with the posterior edge black. Undersurfaces of the wings yellowish white near the body, greyish towards the edge.

Goniocephalus armatus

Agama armata Hardwicke and Gray, 1827.

MATERIAL. BM. 1974. 4952 (♀).

HABITAT. This was found in a latrine pit near the river at the Sungei Kelebang camp (43 m).

Goniocephalus belli

Lophyrus Bellii Duméril and Bibron, 1836.

MATERIAL. BM. 1974. 4953 (♂).

HABITAT. This was caught on the east ridge of Gunong Lawit at 790 m. It was about a metre above the forest floor on the twig of a dead sapling in tall undisturbed hillside forest.

COLOUR. The head is brownish yellow dorsally with the tympanic scale and suborbital scales yellow green. The vertebral region and upper flanks are strongly banded with dark brown and yellow green. The first band forms a collar uniting ventrally behind the gular sac. The brown bands are broader than the yellow green ones and break up on the lower flanks to form a reticulated pattern enclosing enlarged yellow green scales. The tail is strongly banded dark brown and creamy yellow. The throat is fawn with longitudinal, black stripes and pink patches on the sides of the gular sac. The belly is creamy yellow in front, fading behind to cream. The iris is dull gold.

REMARKS. M. A. Smith (1935a) stated that he had examined Duméril and Bibron's type and that it was conspecific with *G. borneensis* (Schlegel). This species has been reported from lowlands to 1525 m.

Goniocephalus chamaeleontinus

Iguana chamaeleontina Laurenti, 1768.

MATERIAL. BM. 1974. 4954–4955 (2 ♀♀).

HABITAT. The first specimen was found at midday less than a metre from the ground on the trunk of a dead tree in undisturbed forest at c. 425 m on Bukit Bok, the ridge separating the Kelebang drainage from the Sungei Petuang. It tried to evade capture by moving to the hidden side of the tree. The other specimen was caught at night a few metres from a rocky stream on the east ridge of G. Lawit at 790 m. It was 3 m up on the trunk of a small sapling among mossy rocks. It was completely inactive, allowing itself to be picked up without attempting to escape. This was typical of all the *Goniocephalus* collected at night; presumably this is a diurnal genus.

COLOUR. The head and body are bright emerald green with black lines radiating from the eye and 2–6 enlarged yellow scales on the upper flanks. The lower flanks have 6 vertical rows of slightly enlarged yellow scales. The gular sac is yellow green and black with the conical scales forming its ventral edge, yellow. The belly is creamy yellow to dark fawn. Proximally the tail is coloured like the body but distally it is crossbarred with pale greenish grey and black. The iris is claret or rich chestnut.

Goniocephalus grandis

Dilophyrus grandis Gray, 1845.

MATERIAL. BM. 1974. 4956–4961 (4 ♂♂, 1 ♀ immature).

HABITAT. The specimens were all found on vegetation by the Sungei Kelebang or nearby streams at 43 m. Along the river there is mainly undisturbed *Saracca* stream vegetation. Two were collected one night on branches and vines overhanging the Kelebang, and one dived into the river when disturbed. Another three were found along a short stretch of a slow, earth-banked stream in disturbed forest not far from a logging track. Two were found on the midribs of palm leaves overhanging the water; they were within 10 m of each other. When disturbed, they dived into the water and swam rapidly under the surface; one was found submerged and sheltering under the bank.

Goniocephalus liogaster

Gonycephalus liogaster Günther, 1872.

MATERIAL. BM. 1974. 4962–4963 (♀ and immature).

HABITAT. The pair were collected within metres of each other on secondary trackside vegetation near the Sungei Kelebang camp (43 m). The female was about 2 m above ground on a slender branch and the immature specimen was about half a metre up on a twig.

COLOUR. They were described in the field as being similar to the *G. belli* but lacking the pink gular patches. The colour pattern is generally similar but the dark flank network includes more and smaller pale areas. The longitudinal dark streaks on the throat merge on the gular sac, but do not form a thick midgular band as in *belli*; in the smaller specimen they form a pair of small ocelli and open-fronted loops, in the female the pattern is similar, but indistinct. The outer rim of the iris is saxe blue.

REMARKS. Boulenger (1887a) described a new species from Malacca as *G. herveyi*. He stated that this differed from *liogaster* in having perfectly smooth dorsal scales, smooth or weakly keeled elongate scales at each side of the dorsal crest, the points on these scales shorter, and an unmarked throat. These slight differences do not seem to have been subsequently questioned. I have examined four specimens from the Malay Peninsula and seven from Pulau Laut in the Bunguran Islands (identified as *herveyi*) and 8 specimens from Borneo (identified as *liogaster*). This material includes the holotype of *herveyi* and five syntypes of *liogaster*.

The dorsal scales of all the specimens are smooth but with keels indicated as a weak median ridge. The scales at the sides of the dorsal crests (the supporting scales) are weakly keeled, the length of their points varies but any population differences are trivial (see below). There are minor differences in throat patterns. Malayan specimens have dark stripes which converge on to the gular pouch from the lower jaw. They are indistinct or absent in mature males. Bunguran specimens are similar, but the stripes may be somewhat broken up on the jaws. Bornean specimens may have completely spotted throats, but usually these spots are more or less confluent into broken stripes in the same position as those of Malayan or Bunguran specimens. One male has unbroken stripes converging on a dark coloured gular pouch. Data on the length of mature males, the height of their nuchal crests, the length of the points on the scales supporting these crests, and data on the subdigital scales of the toes and fingers are given in Table 7.

Table 7 Data on *Goniocephalus liogaster*

		Snout-vent length (mm)	Height of nuchal crest (mm)	Length of points of supporting scales (mm)		
Malaya	2	133-135	20.0-22.0	1.3-2.0		
Bunguran Is.	3	124-145	17.5-25.0	2.1-3.8		
Borneo	4	116-131	17.0-27.8	1.2-2.2		

		Subdigital scales of the toes				
		I	II	III	IV	V
Malaya	N=4	8-9	11-13	15-17	22-24	10-12
Bunguran Is.	N=6	7-9	12-13	14-17	21-24	11-12
Borneo	N=8	7-10	10-13	15-19	20-27	11-13

		Subdigital scales of the fingers				
		I	II	III	IV	V
Malaya	N=4	9-10	13-15	18-20	20-22	11-12
Bunguran Is.	N=6	9-10	13-14	18-19	18-20	10-13
Borneo	N=8	9-11	13-15	17-20	18-23	10-13

The few specimens at my disposal indicate that the differences which Boulenger noted between the types of *herveyi* and *liogaster* are due to individual variation, and suggest that the Malayan and Bornean populations are not significantly different. *Goniocephalus herveyi* (Boulenger) should be placed in the synonymy of *G. liogaster* (Günther).

Family SCINCIDAE

Mabuya multifasciata

Scincus multifasciatus Kuhl, 1820.

MATERIAL. BM. 1974. 4964–4987.

HABITAT. Several specimens, of which only one was collected, were seen among cut, dried *Johannesteysmannia* leaves lying next to a recently built hut on the bank of the Sungei Petuang (250 m). The rocky river banks were covered with sparse natural vegetation forming a community capable of withstanding periodic flooding. They were surrounded by miles of undisturbed, untracked forest. The remaining specimens were shot in secondary trackside vegetation among the logged forest at the Sungei Kelebang (43 m).

Sphenomorphus praesigne

Lygosoma praesigne Boulenger, 1900.

MATERIAL. BM. 1974. 4988 (♂).

HABITAT. Found by day in an emaciated state at the summit ridge camp site at 1280 m. The lizard was seen at the base of a rotten tree stump shortly after masses of peat had been pulled from the cavities under its roots.

COLOUR. The dorsal surfaces are chestnut brown with black mottling. There is a series of five to six large black patches on the side of the neck and the side of the thorax. The venter is immaculate except for black speckling at the sides of the throat and tail. The throat is dull grey green and the neck, belly, undersurface of the tail to its tip and undersurfaces of the limbs are golden yellow.

Family VARANIDAE

Varanus bengalensis nebulosus

Monitor nebulosus Gray in Cuvier, 1831.

MATERIAL. BM. 1974. 4989 (juvenile).

HABITAT. From a dry crevice in the trunk of a fallen tree in disturbed forest near the Sungei Kelebang (43 m).

SERPENTES

Family COLUBRIDAE

Boiga dendrophila cf. *melanota*

Dipsadomorphus dendrophilus var. *melanotus* Boulenger, 1896.

MATERIAL. BM. 1974. 4991 (♀).

HABITAT. Caught at night swimming upstream in a slow stretch of the Sungei Kelebang (43 m).

REMARKS. Brongersma (1934) referred Malay Peninsula *B. dendrophila* tentatively to the subspecies *melanota*. This specimen is typical of Malayan *dendrophila*. There are 223 ventrals, 92 subcaudals, 38 yellow bars on the flanks and 11 yellow spots on the sides of the tail.

Boiga drapiezii

Dipsas drapiezii Boie, 1827.

MATERIAL. BM. 1974. 4992 (immature).

HABITAT. It was caught 1½ m above ground on the frond of a sessile palm (cf. *Eugeissona*) in logged forest near the Sungei Kelebang camp (43 m).

COLOUR. Head and dorsum were medium brown with a series of yellow brown diamond-shaped patches along the vertebral line. Between these patches were vertical crossbars. The upper labials were cream and the chin shields white. Ventral scales were similar to dorsal ground colour, anteriorly very pale brown, merging posteriorly to pinkish brown. The iris was pale ochre.

REMARKS. Ventrals 269, subcaudals 156.

Boiga jaspidea

Triglyphodon jaspideum Dumeril and Bibron, 1854.

MATERIAL. BM. 1974. 4993 (♂).

HABITAT. The specimen was caught at dusk climbing on a *Johannesteysmannia* palm about 1 m from the forest floor near the east ridge camp (790 m).

COLOUR. The dorsum was dusky pink with the vertebral scale row reddish brown and with a paravertebral series of black spots separated from each other by two to three vertebral scales. Alternating with the paravertebral spots is a series of dark bars on the flanks. There were white spots at the base of each bar, on the first dorsal scale row and the lateral edge of the ventral scale. On the posterior body there is a black mark on the lateral third of every other ventral corresponding with the white ventrolateral spots and lateral bars, anteriorly these dark marks are present on every ventral scale. The upper labials are white, spotted with dark brown and the chin shields and lower labials are cream. The anterior half of the belly was sulphur yellow, fading on the posterior ventrals through creamy fawn to pinkish fawn. The entire dorsum and posterior two-thirds of the venter are heavily speckled with black. The iris was pinkish brown.

REMARKS. Ventrals 262, subcaudals 161.

Boiga nigriceps

Dipsas nigriceps Günther, 1863.

MATERIAL. BM. 1974. 4994 (immature).

HABITAT. Found 1 m up in a spiny palm in hillside forest on the east ridge of G. Lawit, 790 m.

COLOUR. The dorsum was a light orange tan. The upper labials, except their dorsal edges, were white as were the chin shields and throat. The anterior ventrals were yellowish, on the posterior body the venter darkened through pinkish orange to orange brown on the tail. The entire dorsum except the upper labials is speckled with black and there is a series of black spots on the tenth and twelfth dorsal scale rows. The iris was pale orange.

REMARKS. Ventrals 265, subcaudals 148.

Rhabdophis chrysargus

Tropidonotus chrysargus Schlegel, 1837.

MATERIAL. BM. 1974. 4990 (immature ♂).

REMARKS. Caught by day in a hut at the Sungei Kelebang campsite (43 m). Ventrals 158+2, subcaudals 85.

Family **VIPERIDAE**

Trimeresurus popeorum

Trimeresurus popeorum Smith, 1937.

MATERIAL. BM. 1974. 4995–5000 (2 ♂♂, ♀ and immature).

HABITAT. Around the east ridge camp (790 m) specimens were caught on vegetation along streams both by night and by day. They were from a few centimetres to one metre above ground level on shrubs, palms and pandan. A male and female (BM. 1974. 4999–5000), from the summit ridge (1280 m), were within metres of each other on boulders in a small stream flowing through a padang.

COLOUR. The dorsum was emerald green and the ventral scales were lime green. The tail was pinkish brown above and the anterior subcaudals were lime green, the posterior subcaudals whitish or brownish. There is sexual dichromatism. The males have the dorsal scales speckled with black and the anterior part of each scale is blackish. The lower half of the first dorsal scale row is claret coloured, the upper half and adjacent edge of the second dorsal scale row is white. In females all the dorsal scales are uniform, except that the posterior edges of the scales of the first row and sometimes their keels, and the adjacent edge of the second scale row, are white. The black dorsal speckling and claret coloured ventrolateral line of the males are absent in females.

REMARKS. Sexual dimorphism is limited to colour, relative tail length and number of subcaudal scales. Data for the specimens are given in Table 8.

Table 8 Data on *Trimeresurus popeorum*

Specimen		Ventrals	Subcaudals	SV length (mm)	Tail length (mm)	Tail/SV
1974.4995	♂	161	79	350	88	0.252
1974.4996	imm. ♂	163	75	289	68	0.235
1974.4997	imm. ♀	164	65	338	68	0.201
1974.4998	imm. ♀	163	66	285	60	0.210
1974.4999	♀	163	66	416	83	0.200
1974.5000	♂	163	70	510	132	0.259

Trimeresurus sumatranus

Coluber sumatranus Raffles, 1822.

MATERIAL. BM. 1974. 5001–5003 (immature).

HABITAT. All specimens were caught during the day in undisturbed forest. 1974. 5001 is from above 250 m on G. Lawit, and 1974. 5002–5003 are from about 300 m on Bukit Bok, the watershed between the Kelebang and Petuang drainages.

COLOUR. Based on 1974. 5002. The dorsal scales are green, flecked with black. The dorsal half of the first scale row and the ventral edge of the second scale row are white in life, without any red. The ventral half of the first dorsal scale row is the same green as the dorsum. Every fourth to fifth dorsal scale along the body is edged anteriorly with black, to give the appearance of dark cross-bars on the body. Anteriorly the dorsal surfaces of the tail are the same colour as the body, except that the white lateral line is on the edges of the subcaudals and adjacent dorsal scale row. The ventrals are lime green and the subcaudals and distal half of the tail are pinkish brown. There is a series of brown spots along the dorsal tail surfaces.

REMARKS. These specimens and two other immature examples (from Betong, extreme southern Thailand, and from G. Dulit, Sarawak) are the only material in the BM(NH) that I would refer to *T. sumatranus*. They have the characteristics given in Table 9.

None has a white postocular stripe, white spots on the sides or white spots or ocelli on the tail. They have three upper labials in contact with the subocular as the usual number, and all have two large scales on the dorsal surface of the snout between the supranasal and supraocular, with the anterior pair separated by their own width or less. These characters, and their comparatively short tails and low average numbers of subcaudals, help to separate them from the closely related

species *hageni* (see Brongersma, 1933; Grandison, 1972). *T. hageni* has generally two or less upper labials in contact with the subocular, usually has small scales between the supranasal and supra-ocular, has 67–85 (mean 73.9, N=13) subcaudals, and has the tail equal to 0.148–0.204 (mean 0.177, N=13) of the total length.

Table 9 Data on *Trimeresurus sumatranus*

Specimen	Locality	Ventrals	Subcaudals	Tail length/ total length
1891.8.29.33	G. Dulit	193	59	0.130
1974.5001	G. Lawit	184	60	0.133
1974.5002	Bt. Bok	183	61	0.133
1974.5003	Bt. Bok	184	71	0.154
1936.9.12.3	Betong	181	63	0.160

The Trengganu specimens have the following scale row reduction formulae

1974.5001	23 $\frac{5+6(17)}{5+6(16)}$	21 $\frac{4+5(115)}{4+5(114)}$	19 $\frac{4+5(122)}{4+5(120)}$	17 $\frac{3+4(148)}{3+4(148)}$	15
1974.5002	23 $\frac{11+12(14)}{11+12(12)}$	21 $\frac{5+6(112)}{5+6(113)}$	19 $\frac{5+6(118)}{5+6(119)}$	17 $\frac{4+5(152)}{4+5(149)}$	15
1974.5003	23 $\frac{5+6(13)}{5+6(14)}$	21 $\frac{5+6(112)}{4+5(109)}$	19 $\frac{5+6(116)}{5+6(116)}$	17 $\frac{4+5(134)}{4+5(128)}$	15

TESTUDINATA

Family TRIONYCHIDAE

Dogania subplana

Trionyx subplanus Geoffroy, 1809.

MATERIAL. BM. 1974. 5004–5005.

HABITAT. One was in an area of interconnecting streams and shallow muddy pools in logged forest at the Sungei Kelebang (43 m). The other was caught at the Sungei Petuang camp at 250 m.

COLOUR. Dorsal surfaces grey brown, the plastron white, the remainder of the ventral surfaces pale grey. The dorsum of the smaller specimen was mottled with black and yellow brown and marked with a black median line and four ocelli edged with yellow brown spots. The iris is pale grey brown to match the dorsum.

Family TESTUDINIDAE

Geochelone emys

Testudo emys Schlegel and S. Müller, 1844.

MATERIAL. BM. 1974. 5006 (skeleton).

HABITAT. This adult was found in the afternoon on a disused logging track near the Sungei Kelebang camp at 43 m.

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